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SCIENTIFIC AMERICAN

A Weekly Review of Progress in

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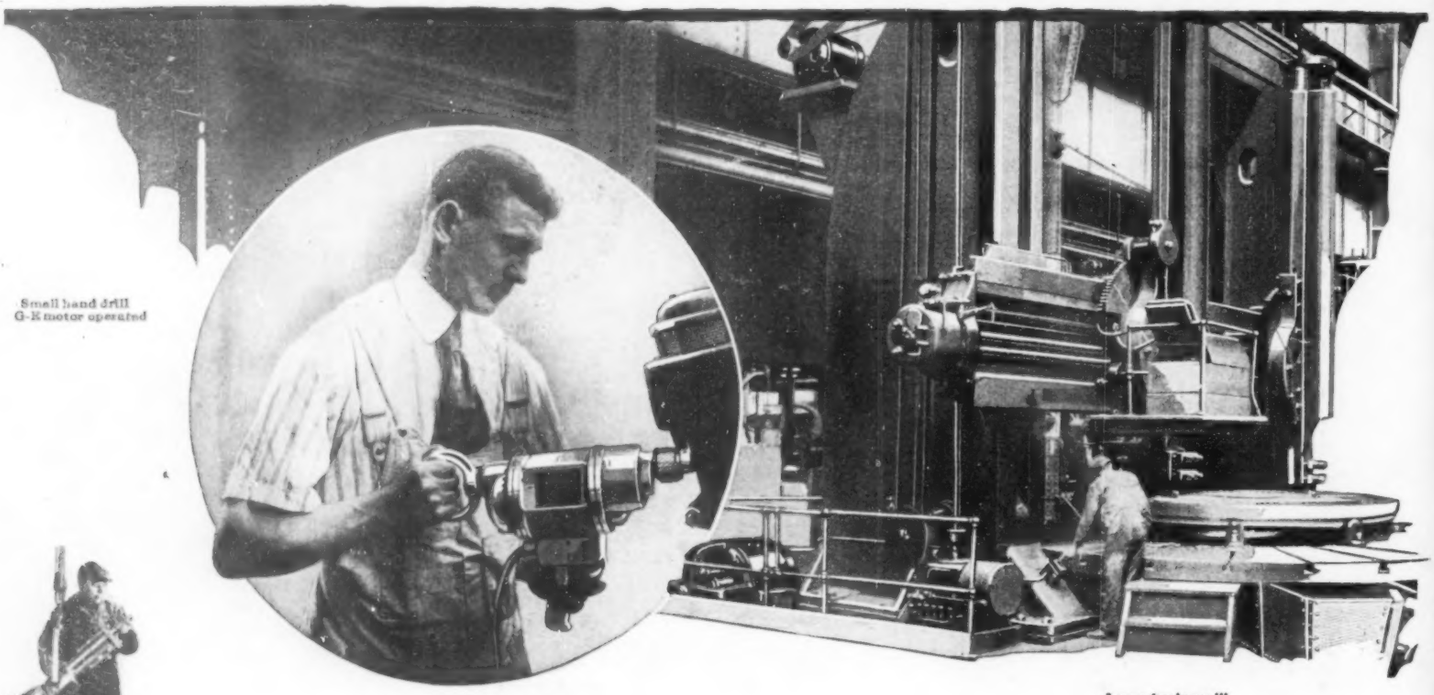

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SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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The True Role of Water Power

By C. D. Wagoner

AFTER 10 years of contention and a serious drain on the coal and oil fields throughout the country, the door has been thrown open for "white coal" to serve industry and the home by the signing of the water power development bill. The vast water powers of the country may now be utilized.

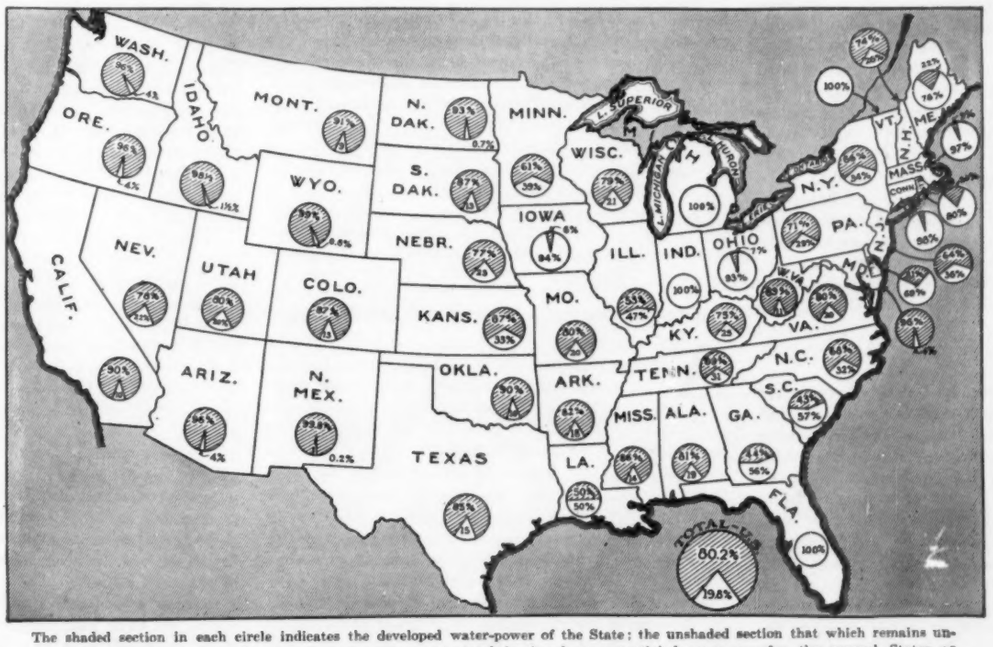
Fifty million horse-power comprises the total, both steam- and water-generated, now in use in the United States. It is conservatively estimated that as much more can be developed by utilization of the water power resources. The Department of the Interior has placed the potential water power at 60,000,000 horse-power of which but 10,000,000 is now developed. This saves the country upward of 33,000,000 tons of coal annually.

Assuming that a steam-produced horse-power generated daily for 12 hours throughout a period of twelve months requires the consumption of five and one-half tons of coal, the substitution of 50,000,000 horse-power from water should make an annual saving of 275,000,000 tons of fuel and avoid the movement of 7,000,000 freight cars. The economic gains, if we made use of our falling waters, would be tremendous, yet there is in service today but 10,000,000 horse-power developed by hydro-electric plants.

It is not contended that water power can entirely take the place of coal. In some instances a substitution for "black coal" cannot be made, but as a supplement it will add greatly to the total, pull down the average cost per unit, set electricity to work in the home far more extensively than at present and bring about such public comforts as the substitution of electricity for coal has done on some of the larger railroads.

But the power of our water can never completely replace the use of coal and oil for power purposes. While the new Federal legislation is a big forward step in fuel conservation, the maximum possible hydraulic energy of the nation is little more than the total energy which we now produce from coal and is about equal to the present total energy consumption of the country including all forms of energy. This means that the idea that when coal once begins to fail we may use the water power of the country as the source of energy, is, and must remain a dream. If all our potential water powers were developed and every rain drop used, it would not supply our present energy demand. Thus hydraulic energy may and should supplement that of coal, but can never entirely replace it as a source of energy. This probably is the strongest argument for efforts to increase the efficiency of our methods of burning coal, and to place at the disposal of the internal combustion engineer both new sources of petroleum fuels and new fuels of non-petroleum nature.

In this country the production of oil has already passed its peak, and in the world as a whole it will in a comparatively few years become of diminishing importance as a power producer, according to experts. There are still large reserves of coal in this country, though the greater ones are in the distant West, and the coal-producing countries are still far from exhaustion, but with the double price of coal, due in part at least to the increased cost of getting it out of the ground, coal-made power will be on the steady rise, it is predicted. In the creation of power, coal and oil are consumed and cannot be replaced. Therefore, it is asserted, the country which in future competition depends wholly or in great part on coal and oil power will be in a position of increasing disadvantage. On all these grounds the full development of our water power is something to which we must give attention.



The shaded section in each circle indicates the developed water-power of the State; the unshaded section that which remains undeveloped. No attempt is made to compare or even to state total developed or potential horse-power for the several States as against each other, but merely to show how far each State has gone in the utilization of such resources as it has.

The extent to which the States of the Union have harnessed the power of their white coal

Repairing the Propeller of a Destroyer

THE *Panama Canal Record* describes an interesting repair made on the starboard propeller of the destroyer "Thornton," in the 1,000-foot dry dock at Balboa in May. The propeller had been damaged by touching one of the banks while in transit through the Canal. The ends of the blades had been turned back through half of a circle. The blades were straightened and brought back to their original surface. Cracks were welded, the broken tips of two blades were repaired by burning (casting new metal into a mold at the end of the tips so that it fused with the old metal), and the propeller was balanced and replaced.

Inasmuch as this is a high-speed turbine propeller, transmitting heavy horse-power and attached to a light hull, lack of balance or truth of surface in the repaired propeller would have set up a serious vibration. After the destroyer had gone to sea the commander telegraphed that the propeller was performing very satisfactorily, and congratulated the Panama Canal on "a difficult repair well carried out."

The Rate of Speed at Which Bacteria Travel

WHEN one observes by means of the ultra-microscope the germs moving in a suspended drop of liquid one is frequently struck not merely by the fact that the form of the trajectory differs according to the species, but also by the difference in the rapidity of travel, which is often very considerable. Some of them move almost indolently, while some travel with great agility in one direction or another, and still others cross the field of observation at such a rate of speed that they give the impression of the flight of an arrow.

The average speed of each species of bacteria can be approximately calculated if one takes care to follow the course, in a suspended drop containing only a few germs, of the individuals which cross the field as nearly as possible along the line of the diameter, from one point to the opposite point on the circumference.

Mr. G. Sanarelli, the Director of the Institute of Hygiene of the University of Rome, continuing the researches previously made by Gabritschewsky, Stigell and Lehmann, and Fried, has determined the speed at which the cholera vibrion travels when the surrounding temperature is 25 degrees Centigrade, with cultures of various stocks 24 hours old developed upon agar-agar and afterwards painstakingly diluted in the serum of the guinea pig.

He found that the apparent average speed of motion is 10 centimeters per second; the actual speed corresponding to this is 0.125 millimeters per second, *i. e.* 7.5 millimeters per minute or 45 centimeters per hour. However, these figures are incapable of giving an idea of the dizzying rapidity of the vibrion as seen in the microscope. This is because the impression of speed obtained does not depend upon the *effective* speed but upon the *angular* speed. Regarded from this point of view the motion of the cholera germ give the same impression as a train passing in front of an observer at a distance of 40 meters at the rate of 16 meters per second or 57.6 kilometers per hour. The cholera germ travels at a much faster rate than any other microbe examined by Mr. Sanarelli, moving three times as fast as the *B. prodigious* and the *B. pyocyanus*, five times as fast as the *B. typhus*, ten times as fast as the coli bacillus and the *Proteus vulgaris*, and twelve times as fast as the *B. megatherium*.

Since all of these bacteria are provided with a number of cilia, while the cholera vibrion has as a rule only a single one, the rapidity at which microbes move appears to bear no connection with the number of their organs of locomotion.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

New York and the Proposed St. Lawrence Waterway

WE have already gone on record as being opposed, so far as New York State and City are concerned, to any diversion of effort from the recently completed barge canal to the proposed waterway through the St. Lawrence River. This does not mean that we are opposed to the St. Lawrence project as such. On the contrary, we believe that as an engineering project it is feasible and that commercially it will ultimately prove to be of great benefit not only to the Western States but to the State of New York and to the industrial centers which lie between the Erie Canal and the Canadian border.

The Erie Canal is an accomplished fact. Excellently built and showing everywhere today its full depth of twelve feet of water, it remains now to furnish the canal with two essentials to its success: first, adequate and thoroughly up-to-date terminals with public grain elevators at Buffalo and New York; and secondly, the removal of Federal operation, limited though it is, and the sale of the present Federal-owned barges to private operators—this last a movement which would encourage private capital to construct a fleet of barges adequate to handle the growing traffic of the canal. We are among those who believe that if these things be done, the new waterway between the Great Lakes and New York Harbor will fulfil all the promises upon which the State was led to commit itself to the labor and cost of construction.

The St. Lawrence project is of a totally different character from that of the State Barge Canal. An International Joint Commission is conducting a series of hearings, both in Canada and the United States, designed to gain information and gage public sentiment upon a scheme for deepening the St. Lawrence River so that it can be used by vessels drawing at least 25 feet of water. The work would be done jointly by the United States and Canadian Governments. The latter has already spent much money upon the St. Lawrence route and is committed to further expenditures. At present it is reconstructing the Welland Canal, which is to have a depth of 25 feet, the total cost of this work being about one hundred million dollars. The work is about one-third completed; but it is realized that the full benefit of this outlay cannot be secured unless the St. Lawrence is rendered navigable to a similar depth. The distance from Lake Ontario to tidewater at Montreal is 181 miles, and the work to be done in deepening the river will be confined to 46 miles of this distance.

The great delay in moving last year's crops, which was due to the congested state of the railroads, has naturally stimulated interest in the proposed St. Lawrence waterway; and it is believed that if deep-sea ships of from 5,000 to 9,000 tons could pass freely between the shipping ports of the Great Lakes and the various ports of the world, not only would the wheat-growing interests of our Western States be benefited, but there would be a very considerable development of other traffic.

On the other hand, it must not be forgotten that the St. Lawrence route will always labor under certain serious disadvantages which can never be removed. For several months of the year the river is closed by ice; and furthermore, even when the river is clear, it is subject to fogs which, as many disasters have shown, render navigation hazardous and naturally tend to increase insurance charges.

To many of us the incidental advantages of opening this waterway seem to be of even greater promise than its direct advantages as a deep-sea route from the Lakes to the Atlantic. The incidental advantages are that the fall of the river and its great volume open up large possibilities of hydraulic-electric development. Thus, in the so-called international section, the river falls 91 feet in 68 miles, and in the Canadian section it falls 130 feet in 70 miles. Preliminary study of the question would indicate that in view of the uniform and heavy flow of water throughout the year, the improvements of the river for navigation will make available a sufficient volume and head of water to produce approximately four million horse-power in the stretch between Lake Ontario and Montreal. The estimated cost of the necessary improvements runs up to three hundred million dollars; but it is believed that the full development of the hydraulic energy would provide sufficient income to pay interest upon the whole cost of the work. So rapid has been the improvement of long-distance transmission that the power thus developed could be made to serve the upper half of New York State, including the cities that border upon the Erie Canal, and it would also be available in New York City and throughout the greater part of New England.

The resulting reduction in coal consumption and the lower cost of power to the industries should appeal strongly to such a manufacturing center as New York State. The Western States naturally are more interested in the improved navigation. In any case, this project is too large and contains too much promise for the future to be ignored or actively combatted by the people of this State. When the Government engineers shall have finished their surveys and a detailed and reliable report on this great project has been presented and passed upon by the International Joint Commission, the city and State of New York will be in a position to judge dispassionately of the merits of the problem. Meanwhile, it will be a good business policy to bend every effort to the development of our own recently completed waterway.

Admiral Benson on Our Merchant Marine

AS a declaration of the aims and policy of our Shipping Board and a statement of the scope of its operations, the recent address of its chairman, Admiral Benson, will be welcomed by those who are following with close attention the operations of that great governmental institution. It is to be regretted that public interest in this matter is not more widely spread. For not alone are the maritime States and, more particularly, the leading ports of this country concerned in our merchant marine, but the great interior States, if they could only be brought to realize it, have an interest that is equally vital.

We are glad to note that Admiral Benson at the outset deprecates the notion that our great shipbuilding effort is promoted merely by a spirit of rivalry. He points out that the operations of the Shipping Board have grown to their present magnitude as the result of war conditions. Previous to the war we were content to see our commerce carried in the bottoms of other nations, and it was not until we were urged by our allies to engage in shipbuilding on a stupendous scale that we attempted to rehabilitate our fast diminishing fleet. At a time when the civilization of the world was at stake we were told that the crying need was for ships and yet more ships. How promptly we responded is a matter of record, and the coming of the armistice found us at the high peak of our effort.

The Shipping Board came into existence several months before we entered the war, and its real purpose was to serve as a regulatory body of shipping, with vast powers that could be utilized to build up our merchant fleet. The magnitude of our accomplishment is seen in the fact that between the declaration of war and the time when our men were ready for hostilities, 95 per cent of their supplies and about 45 per cent of the men themselves were carried over in American bottoms.

We have a total deep sea fleet of over ten million tons; more than half of this is represented by the Shipping Board fleet; and naturally the latter includes the newest and most efficient of our vessels. Having this fleet, and our production of merchantable goods, raw and finished, being greater than ever before in our history, it is the purpose of the Shipping Board to bend every energy to the carrying of these supplies, or at least of the greater part of them, in American bottoms. Admiral Benson states that it is essential that the world should understand that while we fully appreciate the service hitherto rendered by other nations, we are now ship-independent in the development of our ocean-carrying trade.

We are glad to note that the chairman goes on record once more as being thoroughly in favor of private ownership. He tells us that he would use his influence to bring it about "that not only my own but other governments be brought to a point where they fully agree to retire absolutely from ocean carriage," since this would mean only uneven competition with the private owner. "We are endeavoring to do this," says the chairman, "as quickly as possible—and the law demands it."

Radio Control of Naval Units

DOWN through the long history of naval warfare and particularly during the last fifty years of it, successive inventions have been hailed upon their appearance as being "revolutionary." Armor plate, the rapid-firing rifled gun, the torpedo, the torpedo boat, the submarine and now the airplane, have been quoted as destined to turn everything naval upside-down, and lead overnight to the scrapping of the existing instruments of battle and the substitution in their place of the new wonder. In varying degrees, but in infinitely less measure than was predicted, the successive inventions have modified the art, or rather the instruments, of naval warfare; but not once have they revolutionized it. The student of naval history will find that these predictions have come mainly and almost exclusively from the pen of the layman. Rarely is it that the professional mind leaps to extravagant and over-hasty conclusions of this kind. Occasionally it does, and for proof of it we have only to bear in mind the recent pronouncements of Admirals Sir Percy Scott and Lord Fisher.

Just now we are beginning to hear about the great possibilities of distant radio control of naval weapons which hitherto have required direct manual control. Experimental work carried on during the war proved that such control is possible, under favorable conditions, to an extent which before the war would have been scouted as quite impossible. Thus, it was shown that an airplane could be loaded with high explosives, sent up into the air without any pilot aboard, and directed by means of a new radio-control system installed on a pilot machine. It was proved that this controlled machine with its high explosive charge could be flown in the desired direction and made to strike unerringly any desired objective.

In other experimental work, carried out, like that to which we have just referred, under government auspices, it was proved that a torpedo may be steered into contact with its objective by means of radial impulses sent from an observing pilot plane flying overhead. Doubtless in the recent bombing of the old battleship "Indiana," use was made, if not of the same electrical appliances, at least of the same general principle. In this case, the "Indiana," without a single man aboard, steaming at ten knots was steered through radio control from the U. S. S. "Ohio," which maintained a distance of about five miles from the moving target.

It is too early to predict to what extent radio control can be substituted for manual control in aiming and firing the tremendous weapons which modern invention has placed at our disposal. If, for instance, the course of a torpedo can be controlled from an airplane and further experimental work fulfils the promise that is contained in this new method, we shall come nearer to revolutionary changes than ever before. This efficiency under war conditions, however, has yet to be proved.

Electricity

Electrically Deposited Thermocouples.—A method of constructing thermocouples in which one of the elements is deposited electrically on a core, which constitutes the other element of the couple, is described in a recent issue of the London *Engineer*. In particular the couples investigated are those in which constantan is used with either silver or copper.

An Arc Splitter to lengthen the life of contactor tips has just been developed by a leading electric company. It consists of a refractory element which is so placed in the arc box of the magnetic blow-out as to project into the path of the arc, thereby forcing the arc to pass around it and thus increasing its resistance, causing it to rupture more rapidly. The arc splitter is immediately above the contactor tips.

Alternating or Direct Current Bell.—There has been developed an electric bell which operates equally well on alternating and direct current circuits of the proper voltage. The bell is designed so that the speed of the hammer is independent of the frequency of the current. A new principle in bell construction is used, consisting of a buckled steel spring coupled to the armature so that each stroke is very positive in action. The coil is wound on a laminated core and the hammer is under the gong.

Carbon and Commutator Wear.—It is said that although sparking voltages are the same in direct-current and alternating-current machines, the same sparking voltage may give widely different results under different conditions in either type of machine. Experiments are cited to show that the current density has an appreciable influence upon the arcing at the brushes. The influence of temperature and speed upon brush and commutator wear is also taken up in a recent issue of the *Journal* of the American Institute of Electrical Engineers.

Defects in Lead Cables.—While it is possible to detect the approximate location of a defect in a lead-covered cable, it is impossible to remedy the defect and recover the cable at that point without recovering the entire cable. It is sometimes necessary to strip the lead covering from a cable in order to reach a defect that has been discovered during a test, and make the necessary repair. Then the bare cable is again passed through the lead coating machine in order to replace its covering. This work necessarily involves a great expense, but it seems to be part of the business of making huge cables.

A Double-Filament Lamp.—Twice the life of the usual gas-filled lamp is the aim of a manufacturer who has recently introduced a double-filament lamp. This new lamp is placed in the ordinary socket in the same manner as the common type of lamp, and looks and operates in the same manner as the ordinary lamp up to the point where it burns out. Then the bulb is unscrewed from the socket, but, instead of throwing it away, a little cap is removed from the end of the base and the lamp is again put back into the socket. The removal of the little cap from the base brings the terminal of the second filament into place and allows the same lamp to be put back in service. Both the filaments are of equal wearing qualities.

Has the Incandescent Lamp Limit Been Reached?—Judging by the desire on the part of several incandescent lamp manufacturers to edge away from the one-half watt per candle-power rating of gas-filled tungsten lamps, it appears that we have been pushing tungsten filaments pretty hard. That is to say, we have about reached the absolute limit of tungsten filaments at one-half watt per candle-power rating, and if anything, we are too near the fusing point to make for good practice. It appears that greater efficiency with incandescent lamps can only be obtained if we discover some new filament material or a gas which is more suitable than nitrogen. Either of these possibilities seems remote.

Color Screens for Window Lighting.—A development that promises to be an outstanding feature in the practice of show-window lighting, and one that will have an influence upon every other branch of illuminating engineering, has recently made its appearance. Heretofore various devices have been resorted to for producing colored lighting effects, such as dipping the electric lamps in suitable dies, using sheets of colored glass, making the lamp bulbs of colored glass, and so on. But in every instance the heat of the lamp has ruined the colors. The latest device, which is reported to be a complete success, consists of a metal frame supporting a slide of colored gelatine which is held in place by a fine steel mesh. The slide slips in the frame and the latter, in turn, fits over the lamp reflector. In this manner the colors may be readily changed by inserting the desired slide. The colored gelatine holds its color remarkably well and is non-inflammable.

Science

Tree Rings and Climatic Fluctuations.—For nearly twenty years Prof. E. A. Douglass has been studying the annual rings of trees, as found in various parts of the world, in quest of information concerning the history of climates. A complete account of his studies and their results is set forth in Publication 289 of the Carnegie Institution of Washington, "Climatic Cycles and Tree-Growth." Professor Douglass began with investigations on yellow pine in Arizona. By comparison with meteorological records he established the fact that the thickness of the annual rings seen in cross sections of the trees varied with the yearly rainfall. Having determined this relation for the comparatively brief period for which weather records were available he argued that the relation held good for earlier periods, and that sections of old trees would therefore furnish a record of fluctuations of rainfall for hundreds of years. His plan has been to study a group of trees of various species, appropriately located, for each region embraced in his investigations, and he has worked out some ingenious methods and mechanical devices for making his analyses and determining periodicities, etc. Sections were obtained from many parts of the United States and Europe, and, in the case of the *Sequoias* of California, the record has been extended back more than 3,000 years. Among the interesting discoveries announced by Professor Douglass is the fact that practically all the groups of trees investigated show the sunspot cycle or its multiples. There is also found a complex combination of other cycles, including a prominent cycle of about 2 years.

Duration of Thunder.—It is impossible to assign any theoretical limit to the duration of continuous thunder since the sounds of many successive lightning discharges may rumble so long as to merge into one another. In some cases the noise of wind and rain, accompanying the thunderstorm, may be so mingled with the thunder as to help produce the effect of a continuous rumble. The chief factor in the prolongation of a peal of thunder is the difference of time required for the sound to travel to the observer from different points along the path of discharge, which may be a mile, or perhaps several miles, in length. Under some conditions reflection of the sound from clouds, hills, etc., further prolongs the peal. But the Indian thunderstorms are notoriously violent, though comparatively harmless. According to Mountstuart Elphinstone, the setting-in of the monsoon in India is accompanied by such an electric convulsion "as can scarcely be imagined by those who have only seen that phenomenon in a temperate climate. It generally begins with violent blasts of wind, which are succeeded by floods of rain. For some hours lightning is seen almost without intermission; sometimes it only illuminates the sky and shows the clouds near the horizon; at others it discovers the distant hills, and again leaves all in darkness, when in an instant it reappears in vivid and successive flashes, and exhibits the nearest objects in all the brightness of day. During all this time the distant thunder never ceases to roll, and is only silenced by some nearer peal, which bursts on the ear with such a sudden and tremendous crash as can scarcely fail to strike the most insensible heart with awe."

The Water-Supply of Armies.—In a recent lecture by Lieut.-Gen. Sir Thomas Goodwin, K.C.B., of the British Army medical service, on the remarkable progress made in many lines of military hygiene during the war, much novel information was presented concerning methods of purifying the water-supply. Before the war dependence had been placed largely on the use of filter-candles, but they proved unsuitable for active service conditions and were replaced by chlorination. Chloride of lime in the form of bleaching powder was used throughout the war as the means of dealing with all water-supply, either in bulk, as in the big "water-points," or on a smaller scale. Special water-tank companies were eventually organized. These units were able to collect, filter under pressure through sand, sterilize by chlorine gas by means of an ingenious regulator, and transport large quantities of water wherever the motor-lorry could move. Along waterways barges were used for the same purpose. Any flavor of chlorine was removed by a "dechlorinating" process with sulfur dioxide gas. The new water units were also effective in testing water for mineral poisons. The success of water chlorination in the field led to its application to the municipal water-supplies at Boulogne and Rouen. The Americans adopted a similar scheme in some of the larger French towns occupied by their troops. General Goodwin points out that a result of the war has been the recognition of the sanitary service of the army as an organized department, and has aroused general interest in preventive medicine on the part of civilians.

Naval and Merchant Marine

Fate of the "Leviathan".—Admiral Benson, being questioned as to the use to which the "Leviathan" is to be put, admitted that the situaion was a very trying one. He stated that it was difficult for any one firm, in the present state of the money market, to raise the necessary funds to buy the ship and recondition her. The United States Mail Steamship Company made an offer of three million dollars, provided the Shipping Board would make a loan of six million dollars to the company for reconditioning. Another condition of the offer was of 25 per cent of the net earnings of the vessel to the Board for ten years. Admiral Benson stated that personally he felt inclined to accept this offer.

American Shipping in Our Carrying Trade.—A recent United States Shipping Board survey of vessels entering and clearing in the foreign trade with cargo for the first six months of 1920 shows that a total of 15,558 vessels of 86,931,700 deadweight tons have entered and cleared U. S. ports in the six months ending June 30th, carrying 37,398,184 long tons of cargo. Vessels under American registry to the number of 9,550 (61.4 per cent of the total vessels) aggregating 51,534,620 deadweight tons (59.3 per cent of the total tonnage) carried 22,724,217 long tons of cargo (60.8 per cent of the total cargo carried). The American vessels carried 44.1 per cent of capacity load and the foreign vessels 41.5 per cent; the average for all flags being 43 per cent of capacity.

Economy of Electric Drive.—In a paper before the Institute of Marine Engineers, Captain W. P. Durtnall gives some authentic figures showing the relative economy of the reciprocating engine, of the electric drive and of the geared drive. These figures were estimated by the operating engineers of the "Florida" and "Utah," fitted with Parsons turbines, the "Delaware," with reciprocating engines and the "New Mexico," with the electric drive. The relative steam consumption per effective horse-power hour at twelve knots was for the "Florida," 31.8; the "Utah," 28.7; the "Delaware," 21.0; the "New Mexico," 17.3. At twenty-one knots the relative figures given are: "Florida," 13.0; the "Utah," 21.0; the "Delaware," 21.0; and the "New Mexico," 16.4.

Activities of the Shipping Board.—Shipping Board vessels carried during the last fiscal year a total trade of 20,615,402 tons, which passed in and out through 49 United States ports. That there is a marked concentration of this carrying trade is shown by the fact that 26 of the 49 ports handled over 90 per cent of the entire tonnage moved. New York stands first with 27.9 per cent, and Baltimore and Philadelphia next, each with 10 per cent. Next in order comes a southern port, New Orleans, which carried 7.6 per cent, then Norfolk with 7.1 per cent, and San Francisco with 5.1 per cent. A study of these figures shows a remarkable concentration of maritime traffic on the eastern seaboard of the country. The chairman has stated that it would be his policy to bring about a more widely extended distribution.

Ships That Carry the 16-Inch Gun.—We have ten battleships under construction which will carry the 16-inch gun. Of these, four, the "Colorado," the "Maryland," the "Washington" and the "West Virginia" will mount eight 16-in guns, and the "Indiana," the "Iowa," the "Massachusetts," the "Montana," the "North Carolina" and the "South Dakota" will each mount twelve 16-inch guns. In this connection we wish to correct a statement in an article, "Our Naval Standing," which appeared in the SCIENTIFIC AMERICAN of June 26th, where the "California" and the "Tennessee" are each credited with mounting eight 16-inch guns. As a matter of fact, these ships each mount twelve 14-inch guns. There was some discussion of the advisability of giving them eight 16-inch guns when the 16-inch gun, after proof, showed its excellent qualities, but nothing came of it.

The Fate of the Surrendered German Ships.—The ships that formed the remainder of our share of the surrendered German fleet, consisting of the battleship "Ostfriesland," the scout cruiser "Frankfort," three three destroyers and a few submarines will not be incorporated in the active navy of the United States. The "Ostfriesland," the most important of the surrendered ships, was ninth in line at the battle of Jutland. She received no great hurt in that battle but was seriously injured by contact with a mine during the flight of the German fleet in the early morning following the battle. The "Frankfort," a fast cruiser, was actively engaged in the war, especially at Jutland. There are also three destroyers, the G-102, which is somewhat larger than any destroyer of our Navy, the S-132, of about 600 tons, and the B-33. Ultimately, the "Ostfriesland" will be used as a target.

The Problems of Electrification

The Struggle Toward a Standard, and What Is Likely to Come of It

By Robert G. Skerrett

The electric locomotive demonstrating its greater economy and efficiency in terminal yards

ACCORDING to the latest official figures, we have upon our 230,000 miles of steam lines a matter of substantially 2,500,000 freight cars and quite 30,000 freight locomotives, not to mention 15,000 engines at terminals for switching service. Offhand, this array of rolling stock might seem ample for our needs, but an analysis of what it has been doing recently will make it clear that there is something radically faulty in performance, especially in view of the many million tons of goods of all sorts that are cluttering stations and warehouses awaiting much-delayed distribution. To be specific: the final report of the United States Railroad Administration reveals that the average miles per freight car per day were about 22; that each loaded car carried as a rule something less than 30 tons; and that fully one-third of the car miles was run without lading. Finally, we find that each freight engine made an average of approximately but 60 miles every twenty-four hours.

One does not have to be versed in higher mathematics to realize that there is a tremendous lack of service or wastage under existing conditions. Why is this the case? What is the logical relief? It is not necessary to reiterate in detail the multiple operative shortcomings of the steam locomotive, but let us sum up a few of them. It seems that one-quarter of the coal mined annually in this country and six per cent of our fuel oil is consumed by the steam engines of our railways, and a good third of those combustibles is sacrificed in what are termed "stand-by losses." Aside from that, the fuel is inefficiently utilized when the locomotives are actually doing work. Further, the distribution of coal for our trunk lines requires a tonnage movement amounting to approximately 20 per cent of the total freight-ton miles that should yield revenue. This is not hard to understand if we recall the fact that there is first the transportation of the fuel from the mine to the coaling station, then its wanderings on the engine tender, and next the trip of the empty coal car back to the colliery. It is authoritatively declared that the tenders of our steam locomotives of all kinds add about 11 per cent to the ton mileage of our roads without bringing in a return.

Plainly, to just the extent in which we may find a way to reduce the ton mileage of railway coal or oil we shall be able to utilize the cars so freed for the carriage of other essential freight. In 1918, our steam lines burned 163,000,000 tons of coal and 45,700,000 barrels of oil. According to Government data, counting an average load of 30 tons, 5,677,000 car trips were needed to deliver the fuel during that year. This arraignment of the steam locomotive would be incomplete if we failed to take into account the handicaps imposed by seasonal and atmospheric conditions as well as the steam tractor's inadequacy when it comes both to mounting and to descending steep grades with heavy trailing loads.

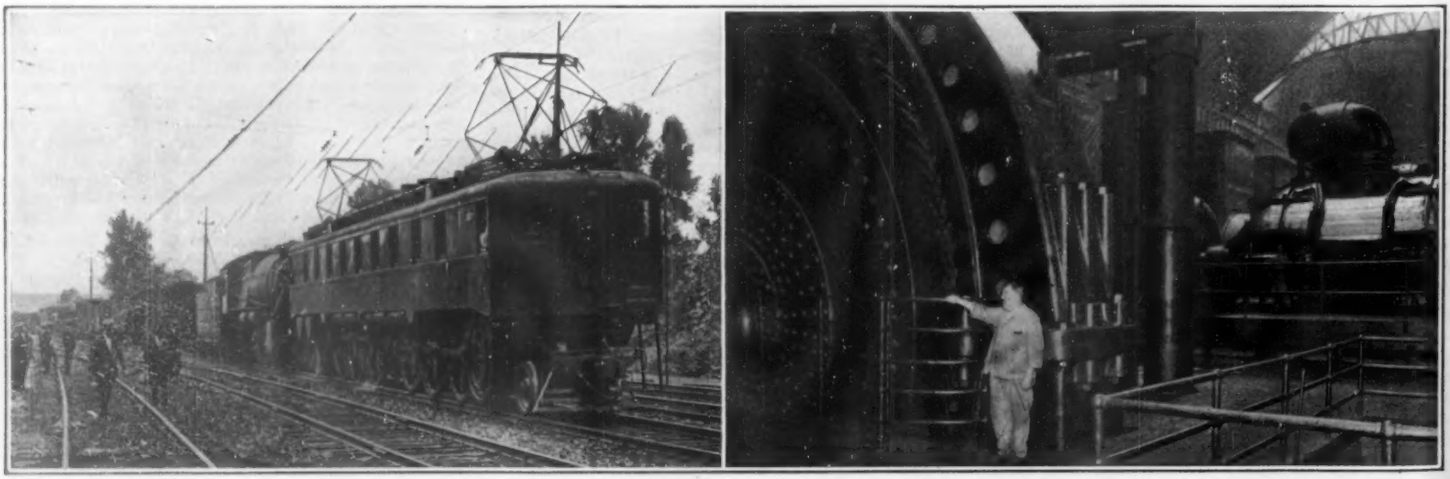
TO tell the average American that we have outgrown steam traction will probably shock him as he casually judges the apparent efficiency of the speeding express, or comes upon an occasional freight train in the course of his daily habit of life. Yet the fact remains that such is the status of our land transportation system when the aggregate movement of cars and tonnage is considered. Our national well-being is contingent upon an improvement in this matter; and it appears that improvement is possible only through the substitution of electricity for steam as a motive power. Mr. Skerrett tells us in this article something of the manner in which this substitution must be effected.—THE EDITOR.

Anyone with a moderate knowledge of the physical geography of the United States must be alive to the fact that the mountainous nature of many sections interferes greatly with rapid movement on the part of both passenger and freight service, but much more so in the case of freight trains. Because of numerous heavy gradients, engineering difficulties, and the expense entailed, the mountain routes are frequently single-track lines and seldom more than double track. Thus, the tide of traffic is slowed down and passed through constricted channels. This would not be so bad if the steam engine could maintain a higher speed when climbing and descending these slopes, but unfortunately the steam locomotive cannot do this. It must materially reduce its load when going up hill in order to pull the train along and, because of its deficient grip upon the rails it often cannot hold safely back the same number of laden cars when sweeping down the opposite incline.

Therefore, we have a reversal of the very action upon which we normally count when we seek to shift from one reservoir to another a given fluid volume by means of a relatively small connecting conduit. That is to say, just where increased velocity is essential on our railways we cannot have it. Every now and then some of our steam roads—and these frequently among our most important trunk lines—have to contend with this bottle-necking, and it is at these points or along these sections that the freight movement is throttled.

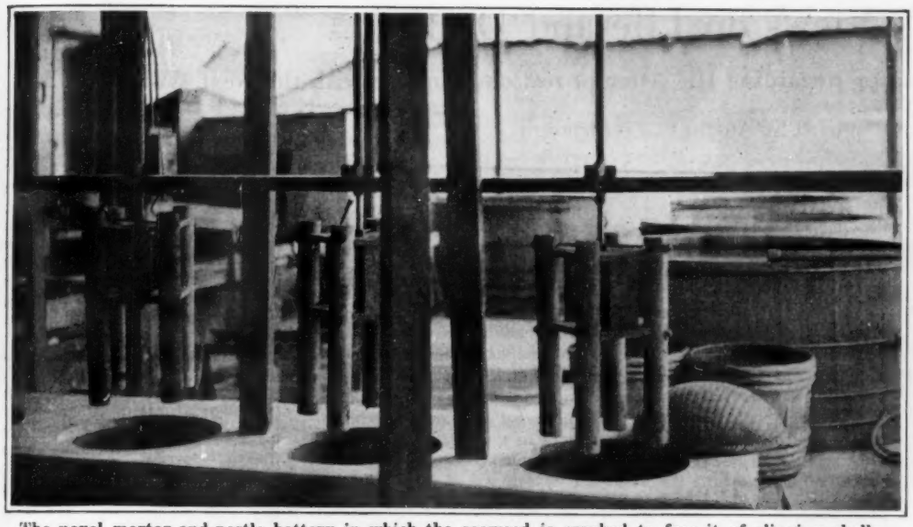
The apparent solution of the problem, which is becoming more and more acute from year to year, is the substitution of electric traction. Out west one transcontinental road is pulling trains of 4,000 tons up and down steep mountain slopes and exercising perfect control the while. It is doing this at speeds hitherto unattained under like circumstances, and the schedule is being maintained with remarkable regularity. Not only that, but the oper-

(*Continued on page 457*)



Left: A powerful electric locomotive of special design that has saved the day in speeding up freight traffic on one trunk line. *Right:* In the foreground a big dynamo driven by reciprocating engine; in the middle distance a steam turbo-generator set of like power, much higher efficiency, and far less bulk. Where fuel must be employed for the generation of current, it is units of the latter type that will be relied on in large railroad central stations

Typical units that are making electrification of our railroads a success



The novel mortar-and-pestle battery in which the seaweed is crushed to free it of clinging shells, sand and alkali

Agar-agar—the finished article in silvery sheaves of an average weight of three pounds each

California's Seaweed Industry

By John L. Von Blon

AGAR-AGAR, that valuable aid to medical science and important food adjunct for the supply of which the world heretofore has relied solely upon the Orient, is about to be extensively manufactured in the United States. An American company already is turning out a third of a ton daily in a finely-equipped plant at Glendale, a suburb of Los Angeles, California, and steadily will increase its capacity. Thirty-five thousand dollars' worth of specially-designed machinery has been installed in an artistic concrete building having 15,000 square feet of floor space and a five-acre surrounding lot which also is utilized. This marks the establishment of a new industry with great possibilities, or rather the transplanting of an old one to virgin soil. And it is an interesting progressive departure inasmuch as only crude mechanical appliances are used in the Far East.

Japan has enjoyed a monopoly in agar-agar, and last year this country imported 240 tons, of approximately half a million dollars' worth from there, and Great Britain and other European countries much more. Consumption is heavily increasing although the public generally never has heard the name. It is a gelatin-like derivative of seaweeds and meets wants which nothing else can. In Japan but ten species of the marine algae required are found. Two years' diligent research disclosed that fifteen species of superior quality grow in comparative abundance along the southern California coast. The Glendale factory is the result. There it is demonstrated that the American finished article far excels the hand-made oriental product. In their eagerness to increase their profits the Japanese mixed plants other than algae with seaweeds and thus imposed upon the entire world. One of the large eastern pharmaceutical manufacturing concerns is negotiating for the whole California output, and the War Department also is looking to that end. A certain prepared package of agar-agar weighing eight ounces sells for about a dollar.

"Kanten," as the Japanese call agar-agar, long has been esteemed there as a food, and as such it appeals more and more everywhere. It is a wholesome and delicious thickener in jellies of all sorts, fruit, meat or fish. It is particularly beneficial mixed with any ordinary cereal or breakfast foods with the addition of sugar or salt. In candy making, too, this strange gift of the ocean is a factor. It goes far and a pound is sufficient to supply an ordinary family for many months; but the price has jumped from 50 cents to $1.25 and over during the emergency of the past few years.

The major demand is from hospitals, laboratories and the medical profession. The peculiar substance has no equal as a culture media for bacteria, retaining its solidity, unlike gelatin, at the requisite temperatures, and thus proving indispensable to bacteriological research and segregation. During the war it figured successfully in the healing of certain wounds. It has the natural property of absorbing water and retaining it; and, in medicine, the additional property of resisting the action of intestinal bacteria and of the digestive enzymes. It is employed as a mechanical stimulant or alterative to overcome constipation without the violent action characteristic of effective cathartics. It has no inherent flavor, little nourishing power, and doesn't digest. It promises to displace many drugs which leave harmful after-effects.

Those seaweeds constituting the basis of agar-agar are prolific off Cayucos, San Luis Obispo, Santa Barbara, Los Angeles, Oceanside and down along Lower California. Among others are *Geldium corneum* and *cartilagineum*, *Gracellaria confervoides*, *Euchema spinosium*, and various forms of *Tenax* and *Gigarteneae*. The leaves, dainty and beautiful, brilliant red, purple, pink, yellow, white or black, are hunted on the beaches by tourists and pressed and treasured as "sea moss." The plants grow only on rocks and as a rule where they can be gathered at low tide, though in some localities expert divers get the best. Off California they attain a height of two feet and are slightly coarse. In Japan, stunted by 250 years of picking, half that size is the maximum. The average worker on fairly good "ground" can harvest 200 (dried) weed, or one bag per day, and for this he is paid $20 f.o.b. Glendale—10 cents a pound. To get 200 pounds of dry weed he must pick 600 pounds wet. It is pulled up with the hands. Most of the supply comes from fishermen under contract, and American labor is so high that they find it more profitable to carry the algæ up from Mexico, where four boat crews now are working.

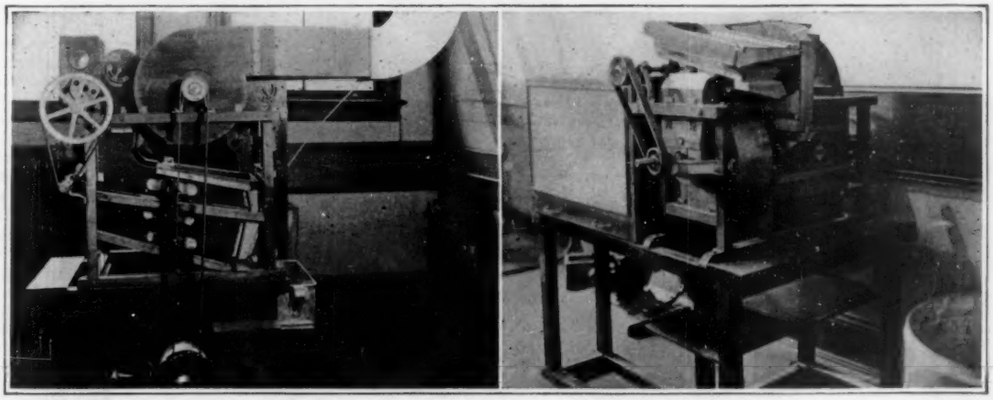
(*Continued on page 458*)

Setting Federal Wheat Standards

By George H. Dacy

IN order to evolve grain-grading standards of general application and satisfaction, the scientists of the Federal farming forces at Washington are now utilizing a minature flour-milling plant and bakery in order to test out all of the varieties of wheat grown in this country and to ascertain definitely their intrinsic value as measured in terms of the size and quality of the loaves which they produce. The small scale testing plant is outfitted as far as possible as an exact replica of a large commercial mill. Its equipment includes two grain separators and a scouring machine which remove foreign matter from the wheat and prepare it for tempering and milling. The mill proper, which is of the non-automatic type, consists of four single stands of six-by-six-inch rolls, three of which are corrugated while the other is smooth. It is operated in such a manner that it practically duplicates the flow of a five-break, nine-reduction roller mill such as is largely used commercially.

After the samples of wheat have been graded according to the Federal standards now in effect, the grain is cleaned and then passes through the mill which converts the kernels into flour. The flour is stored for a few days and then is made into dough and baked into bread in the miniature bake-shop which is operated in conjunction with the flour mill. The bakery is equipped with a modern electric baking-oven, an up-to-date dough-mixing outfit and a sponging cabinet heated by electricity where the dough is placed for rising. After each sample of flour is converted into bread, the latter product is examined carefully as to color, texture, flavor of the bread and expansion of the loaf, these data being of value in checking up the baking qualities of the flour as compared with its milling merits. All this information is useful in checking up the grain-grading records of the various samples of wheat tested. Every variety of wheat in the country—of which there are over 150 different kinds—will be tested out by Uncle Sam's scientific experts and the results of these investigations will be of ultimate and future value to every bread consumer in the entire country.



The receiving separator that cleans out the weed-seed, chaff, straw and other foreign matter from the grain.

The scouring machine that eliminates the smut, beards, and other material that cling to the bran.

Accessories of Uncle Sam's miniature mill and bakery that are employed in standardizing grain tests

Nickel Babbitt

FOUNDRY, in answer to a question states that many so-called nickel babbitts contain no nickel, but that a nickel babbitt can be made containing 4 per cent of copper, ½ per cent nickel, 10 per cent antimony, and 85½ per cent tin. The copper and nickel are charged together and covered with charcoal. Antimony is added gradually, and then the tin.

Edison's Views on Life and Death

An Interview with the Famous Inventor Regarding His Attempt to Communicate with the Next World

As Reported by Austin C. Lescarboura

WHEN a man of the standing and personality of a Lodge or an Edison interests himself in a subject, the public is never cold to the announcement of what he is doing and what he hopes to accomplish. So when the news went out, the other day, that Edison was carrying on experiments looking toward communication with the dead, the newspapers gave the item a place out of all proportion to that which its intrinsic importance in the scientific progress of the day and the stage to which Edison's work has progressed would have entitled it. In this they were quite right, because their readers were interested in the bare news that Edison was working on the problem. We believe that our readers, too, are interested in what Edison is doing in this field and what he has to say about his theories and his work. Hence this interview, in which Mr. Edison, himself, tells us what he believes about survival and why he hopes to establish communication. And if one thing stands out clearly beyond all other things in this interview, it is that regardless of the manner in which sensational newspaper stories may present the matter, Edison stands for a return to sanity in our attitude toward the possibility of survival of personality and communication with those who may have survived.—THE EDITOR.

EDISON—the man who has given us the electric light, the phonograph, the motion picture, the nickel-iron storage battery, the perfected dynamo and a vast collection of other devices entering into our everyday life—is about to devote himself to something which is infinitely more interesting than any invention can ever be. Here we are, something like one billion five hundred million human beings, facing death sooner or later yet totally ignorant of what is to become of our personalities. And the same can be said about our coming into this world, for life and death remain the greatest mysteries of the ages.

Several weeks ago the word was passed around to the effect that the great inventor was working on a device, or apparatus as he prefers to term it, to communicate with personalities which have passed on to another existence or sphere. Immediately the press of the United States and Europe announced that Thomas A. Edison had joined the ranks of the spiritists, which now number many a prominent scientist, author, inventor, physicist, engineer, clergyman, and so on. Soon the highly imaginative French writers drew pen pictures of Mr. Edison's apparatus serving as a telephone station or telegraph office or whatnot, where persons wishing to communicate with those who have passed on could do so in a positive and prompt manner.

And no one is more sorry than Mr. Edison that this impression has been permitted to gain ground both here and abroad. "In the first place, I cannot conceive such a thing as a spirit," said Mr. Edison to the writer. He meant it, too. "Imagine something which has no weight, no material form, no mass; in a word, imagine nothing! I cannot be a party to the belief that spirits exist and can be seen under certain circumstances and can be made to tilt tables and rap and do other things of a similar unimportant nature. The whole thing is so absurd."

In fact, it was mainly for the reason of correcting the impression about Mr. Edison's activities in this latest field of research that the inventor granted the writer an interview. The apparatus which he is reported to be building is still in the experimental stage. Obviously, Mr. Edison is too cautious and too well founded in the uncertainties of any new experimental work to say anything definite at the present time. However, he wishes to say the following, which is very significant in the light of his past record in so many fields of endeavor:

"I have been thinking for some time of a machine or apparatus which could be operated by personalities which have passed on to another existence or sphere. Now follow me carefully; I don't claim that our personalities pass on to another existence or sphere. I don't claim anything because I don't know anything about the subject. For that matter, no human being knows. But I do claim that it is possible to construct an apparatus which will be so delicate that if there are personalities in another existence or sphere who wish to get in touch with us in this existence or sphere, this apparatus will at least give them a better opportunity to express themselves than the tilting tables and raps and ouija boards and mediums and the other crude methods now purported to be the only means of communication.

"In truth, it is the crudeness of the present methods that makes me doubt the authenticity of purported communications with deceased persons. Why should personalities in another existence or sphere waste their time working a little triangular piece of wood over a board with certain lettering on it? Why should such personalities play pranks with a table? The whole business seems so childish to me that I frankly cannot give it my serious consideration. I believe that if we are to make any real progress in psychic investigation, we must do it with scientific apparatus and in a scientific manner, just as we do in medicine, electricity, chemistry, and other fields.

"Now what I purpose to do is to furnish psychic investigators with an apparatus which will give a scientific aspect to their work. This apparatus, let me explain, is in the nature of a valve, so to speak. That is to say, the slightest conceivable effort is made to exert many times its initial power for indicative purposes. It is similar to a modern power house, where man, with his relatively puny one-eighth horse-power, turns a valve which starts a 50,000-horse-power steam turbine. My apparatus is along those lines, in that the slightest effort which it intercepts will be magnified many times so as to give us whatever form of record we desire for the purpose of investigation. Beyond that I don't care to say anything further regarding its nature. I have been working out the details for some time; indeed, a collaborator in this work died only the other day. In that he knew exactly what I am after in this work, I believe he ought to be the first to use it if he is able to do so. Of course, don't forget that I am making no claims for the survival of personality; I am not promising communication with those who have passed out of this life. I merely state that I am giving the psychic investigators an apparatus which may help them in their work, just as optical experts have given the microscope to the medical world. And if this apparatus fails to reveal anything of exceptional interest, I am afraid that I shall have lost all faith in the survival of personality as we know it in this existence."

Mr. Edison does not believe in the present theories of life and death. Long ago he turned his back on the various old and accepted theories because he felt that they were fundamentally wrong. And just as he experimented with one substance after another without ever becoming discouraged in his search for the filament of the first successful incandescent electric lamp, so he has searched and reasoned and built up a structure which represents his theories of what is life.

"I believe that life, like matter, is indestructible," began Mr. Edison, in outlining his theory of life and death. "There has always been a certain amount of life on this world and there will always be the same amount. You cannot create life; you cannot destroy life; you cannot multiply life.

"I believe our bodies are composed of myriads and myriads of infinitesimal entities, each in itself a unit of life, which band together to build a man. We have taken it for granted that each of us is a unit. We think of a cat, an elephant, a horse, a fish and so on as units. I am convinced that such thinking is basically wrong. All these things appear to be units only for the reason that the life entities of which I speak are far too small to be detected even with the ultra-microscope.

"The question has been raised that if these life entities are so small, they cannot be large enough to include a collection of organs capable of carrying on the tasks which I am about to mention. Yet why not? There is no limit to the smallness of things, just as there is no limit as to largeness. The electron theory gives us a reply which is wholly satisfactory. I have had the matter roughly calculated and have at hand the data of the calculation. I am sure that a highly organized entity, consisting of millions of electrons yet still remaining too small to be visible through any existing microscope, is possible.

"There are many indications that we human beings act as a community or ensemble rather than as units. That is why I believe that each of us comprises mil-

(Continued on page 458)

Copyright, Thomas A. Edison, Inc.

Thomas A. Edison—the world's foremost inventor—who is now at work on an apparatus designed to place psychical research on a scientific basis

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Record Weather

To the Editor of the SCIENTIFIC AMERICAN:

In an article in your columns a year or more ago it was stated that a record of temperature by the United States Weather Bureau station at Greenland Ranch, on the border of Death Valley, showed 134° in the shade. In the article "Record Weather" in your issue of August 21st the mark is set much lower than that. It is regrettable to have such discrepancies creep in, for an error in the figure that one happens to know about tends to cast suspicion on all the other figures that one does not know about. A. I. LOOP.

North East, Pa.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of August 21st it is stated that Fort McDowell, Ariz., holds the record for heat in this country, with a maximum of 119° Fahrenheit, and that the highest known temperature is reported from Algeria at 127.4°. A brief search of the records from 1897 to 1908 discloses seventy-seven records of 120° or more from stations in southeastern California and southwestern Arizona, culminating with 128° at Volcan Springs, Cal., July 9th, 1905, and 129° in the same place June 23rd, 1902. It might also be of interest that temperatures of 110° and more are frequently recorded at Yuma, though this is by no means the hottest station in the region. At Aztec, Ariz., in July, 1905, the average daily maximum for the month reached the astounding figure of 117.9°. H. A. GLEASON.

New York City.

To the Editor of the SCIENTIFIC AMERICAN:

I notice in the issue of August 21st the statement that Cherra Punji, India, has the heaviest rainfall in the world. Sometime ago you published the statement that a spot in the Hawaiian Islands had been found with a heavier rainfall. Which is correct?

Cleveland, Ohio. HERBERT W. ROSS.

To the Editor of the SCIENTIFIC AMERICAN:

In reply to the criticisms called forth by my article "Record Weather," I am afraid I must plead guilty so far as the Greenland Ranch high temperature record is concerned. This record was made on July 10th, 1913, by a fully authenticated instrument, and stands as the highest official mark for this country or any other. I do not yet understand how I missed this, as it was among the Weather Bureau records that were placed at my disposal during the preparation of the article.

As regards the balance of the article, I may say that the Weather Bureau, which receives and files the SCIENTIFIC AMERICAN each week, has filed this copy with two corrections in my article—this one, and another making the West Indian hurricanes occur "usually" between June and October, instead of "always" during this interval, as I had it. Aside from these two items, the Weather Bureau has no exception to take to my article, and I am sure will inform you to this effect if you inquire of them.

While it is true that every statement in the article with these exceptions is true so far as official records go, it is of course equally true that many readings higher than the highest official one and lower than the lowest official one are on record. We all know that the thermometers used by the Weather Bureau are the only ones recognized as accurate, especially in the recording of extremes. At times thermometers will vary by as much as five to eight degrees when hanging side by side. It seems a bit rough to throw out a record which may be perfectly all right, on the mere ground that the thermometer was not properly verified, but the same thing happens in other matters of record every day, and there is really no other help for it. The Hawaiian rainfall record is another case of the same sort. I have no doubt that it occurred substantially as reported, but it is not official and that is all that can be said on the matter.

I may say that there have been recorded, so recently that they are now on the files of the Weather Bureau but were not there when I compiled my article, new world extremes at both ends of the temperature scale. One of these, from Africa, raises the Greenland Ranch record a fraction of a degree; the other, from Western Canada, lowers the extreme mark of officially observed cold to the same extent.

Washington, D. C. WENDELL WHITING.

To the Editor of the SCIENTIFIC AMERICAN:

Referring to your recent paper on Record Weather, the Weather Bureau publishes daily precipitation reports but they do not seem to record what is just as important, particularly just now in California, the daily evaporation per square mile. This would apparently give an indication of climate useful to the farmer and to certain industries.

Vallejo, Cal. C. E. BURNLEY.

The Time-Space Manifold

To the Editor of the SCIENTIFIC AMERICAN:

The time-space concept clarifies our idea of time which may be defined as a fiction of the finite and three-dimensionally-conditioned intellect, devised to differentiate, locate and dislocate events in the cosmic change and experience. Time is linear and directed; it is therefore reëntrant, an infinity of time being circular and returning upon itself. I infer that hyperdimensional time possesses qualities of superficiality, such as spreading or stretching; a hyper-dimensional (4 or "n") time-infinity is spherical in three-space and dislocated events or changes in three-space are hyperdimensionally synchronous.

New York. ALBERT R. GALLATIN.

The Air Service Corrects Us

To the Editor of the SCIENTIFIC AMERICAN:

On page 253 of the SCIENTIFIC AMERICAN for September 11th, 1920, it is stated that, "the Verville-Packard airplane was designed and built by the Packard Motor Car Company under the guidance of Col. J. G. Vincent." This statement is entirely incorrect, since the Packard Motor Car Company had no part in the design or construction of the airplane, their share in the development being confined solely to the engine. The Engineering Division of the Air Service at McCook Field designed and constructed the Air Service entry entirely in their own shops. The designation is not "Verville-Packard," but should be, "Engineering Division Model V.C.P.R."

In the same issue on page 251 under the title "Making Doubly Sure of the Parachute Jump" occurs the sentence, "If one parachute fails to open, which sometimes happens, the other by all the rules of probability should open." This sentence gives the impression that Air Service parachutes occasionally fail to function. It may be stated unequivocally, that the Air Service parachutes have never failed to open successfully, although an instance is on record where a civilian jumper, in testing a parachute built by a private concern, was saved from certain death by the fact of his having an Air Service standard parachute in reserve.

McCook Field. THURMAN H. BANE, Major, A. S.

American Engines

To the Editor of the SCIENTIFIC AMERICAN:

In the September 4th issue of your magazine one of your correspondents makes a statement to the effect that as engine designers the Americans excel all others. A statement of that kind is gross error and calls for criticism.

There are a few things that we Americans should know. We should know that Europe, especially Germany, has developed engines far more efficient than our own. Mr. G. F. Gebhardt, in his *Steam Power Plant Engineering*, says that while the average American 40-horse-power plant has an efficiency of seven per cent, in Germany it runs anywhere between twelve and fourteen per cent. Another thing that we should remember is this: The best American flying machine with two motors, 400 horse-power each, can carry 800 pounds, using fifty-six gallons of fuel to the hour; while a German machine, with a 160 horse-power motor, can carry 1,000 pounds, using seven gallons of fuel per hour!

I believe that no further proof is necessary to convince some of your engineers that there is much to be done before we can boast that we hold first place in engine design. N. T. PELFF.

University of Illinois.

The Dairy Problem

To the Editor of the SCIENTIFIC AMERICAN:

The dairy presents some peculiar and paradoxical problems. Milk production as a general thing must be followed by an entire community. There must be sufficient production to maintain a receiving station; the withdrawing of a few dairies may close a creamery or cheese factory and force others to abandon dairying.

Milk production and beef-raising are interwoven. About one-seventh of the dairy cows of this State are killed each year. Some of these are young animals that have proven poor producers but most of them are worn out and old. High prices and low prices for beef are equally disturbing: the former encourages the killing of producing cows, and the latter the retention of worn-out animals. Usually the beef value of a cow is only a fraction of the cost of raising her. About three-eighths of a cow's life is unprofitable. The first two years are without any production whatever; the next two are below par, and there is a rest period of about two months each year.

A few years ago much of the milk produced in this State was used in the production of butter. The skim milk was fed to hogs. At present much of the milk is used in liquid form. Where it is skimmed for the cream the skim milk is made into cheese. This means less pork and more cheese. The food value of the cheese from a given quantity of skim milk exceeds the value of the pork.

Jefferson, N. Y. R. C. JONES.

Caring for the Cone Clutch

To the Editor of the SCIENTIFIC AMERICAN:

On page 297 of your September 25th, 1920, issue you explain partly why a cone clutch becomes harsh, and some of the remedies.

I would like to add that the reason the smooth hard clutch is harsh or "rank" is that it has no high spots to allow it to engage gradually, but on the contrary engages with all its surface and all its power at once or not at all.

The sponging and oiling process is all right but must be followed up by blocking out the clutch when not in use, otherwise the leather is so compressed that it cannot absorb the oil and the effort is therefore wasted.

I would like to add that in my opinion ninety per cent of rear end trouble is directly caused by poorly constructed and poorly operated clutches and that the life of the car might be doubled and the upkeep expense materially lessened by more attention to the proper functioning of this important unit, not only by the designing engineer, but also by reasonable care on the part of the operator.

Hackensack, N. J. S. S. VAN DUSEN.

Riding the Air in a Balloon Without a Basket

THE national balloon race which started from North Birmingham, Ala., on September 25th, brought out a spectacular feat which we believe gives the lie to the assertion that there is nothing new under the sun. One of the competing balloons, manned by Lieutenants Emerson and Sloman of the United States Navy, in passing over Kentucky was forced to do a good deal of vertical dodging of thunderstorms, its maneuvers including two landings. As a result so much gas was lost out of the big bag that it lacked sufficient lifting power to stay in the race under the usual conditions. The two lieutenants met this situation by cutting away the pilot's basket, and taking the air again, clinging to the balloon rigging above the concentration ring. As if this stunt were not in itself sufficiently perilous, the ingenious ballooners ran into further storms in the Lake Erie region, of such intensity as to render a final landing imperative. In order to effect this landing they had then to slit the fabric of the balloon. They finally came down in an Ohio hay field, after a flight of 37 hours 1 minute, of which 13 hours was without the basket. The distance covered from the starting point was 590 miles, and the extraordinary means employed to stay in the race resulted in the capture of third place by the daring improvisators. It may be remarked, further, that the final landing was made without injury to the operators or the remaining equipment. We hope that this stunt will not become standard practice, but in any event we feel that it well merits the place we have given it on our cover this week.

A Call for Volunteers

VARIABLE star observing is a little known and yet highly important line of telescopic research work that is worthy of wider publicity, chiefly because it offers to the owner of a small telescope, say of three-inch aperture or larger, an opportunity to contribute observations of scientific value.

The American Association of Variable Star Observers was founded in 1911; it now has a membership of over two hundred, mostly amateurs. During the past nine years its members have contributed and published over 100,000 observations.

The dues of the Association are $2.00 per annum. A cordial invitation is extended to all interested in promoting the advance of astronomical knowledge to join its ranks. The work is entirely visual, not in the least difficult, involves no mathematics, and is of fascinating interest.

Further information and application blanks may be obtained by addressing the Secretary, W. T. Olcott, Norwich, Conn.

Revising High Bridge

Five Alternative Official Plans for Doing Away with the Piers that Obstruct Navigation

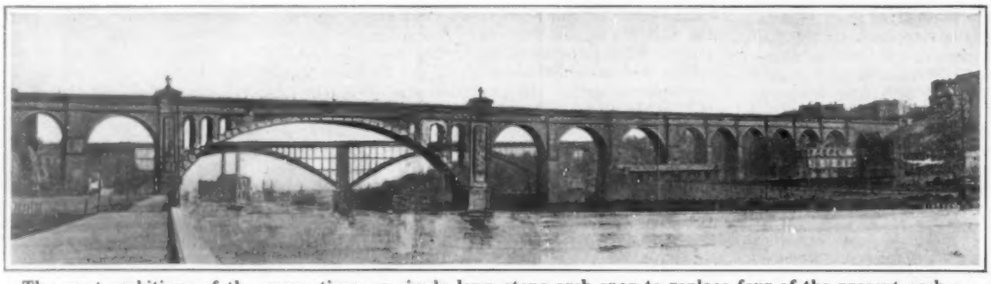
By W. B. West

THE general outlines of the situation presented by High Bridge, over the Harlem River about opposite West 174th Street, New York, are familiar enough to the readers of the SCIENTIFIC AMERICAN, but may bear a brief recapitulation. The bridge was built nearly three-quarters of a century ago, as a means of carrying the original Croton Aqueduct across the Harlem River; and in fact still forms a part of the water-supply system of the city, though no longer a part of first importance. As a natural consequence of its character, the bridge was built in the multiple-arch type, with five arches (four piers), making up the river span and in addition a number at the ends, especially the east end, to carry the rather high level of the structure back to the high but sloping bank.

At the time of its building the bridge was distinctly out in the country; and the Harlem River over which it stood was subject to little traffic, and that little largely for pleasure. With the growth of the city and the city's business, the establishment of great railroad terminals at the south end of the river, and the development of Erie Canal traffic, there grew up a very considerable congestion in the Hudson River and about the lower reaches of the Harlem—a congestion which was relieved by the construction of the Harlem River Ship Canal. This passage cuts through the low ridge of rock which separates the Hudson and Harlem River valleys at Spuyten Duyvil and Kingsbridge, and makes the Harlem what the present generation knows it for—less a true river than a strait, similar to the East River, and connecting the Hudson River with Long Island Sound and the great freight terminals of Mott Haven by a route that eliminates the long haul around the lower end of Manhattan Island.

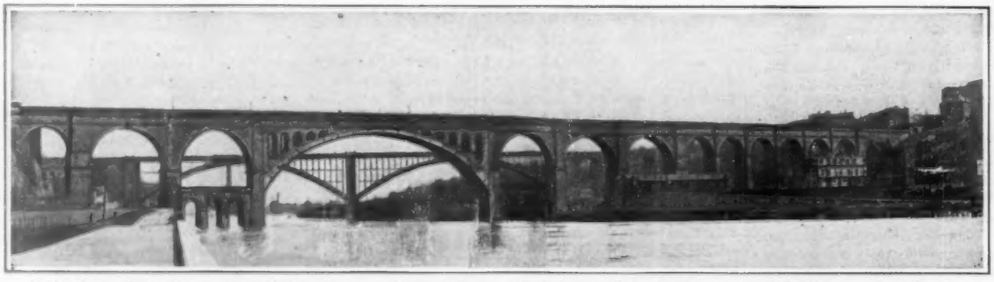
As a consequence of all this, traffic on the Harlem River today is quite heavy, sufficiently so, in fact, to make the heavy stone arches of High Bridge a serious impediment. For the passageway allowed beneath these arches gives the big harbor barges a very small clearance, and it is not unusual for a tow to scrape more or less badly in getting through, while the treacherous currents set up by the very presence of the piers in the river now and then furnish the setting for a real wreck. The War Department, under its control of navigable streams, has long objected to the presence of these piers, but has never brought the matter to an issue. Now it has done so, however, and the city is faced with the alternative of removing or remodeling High Bridge.

The scheme that stands out, architecturally, as fundamentally distinct from the other four, involving two new longer spans, each replacing two of the older and shorter ones

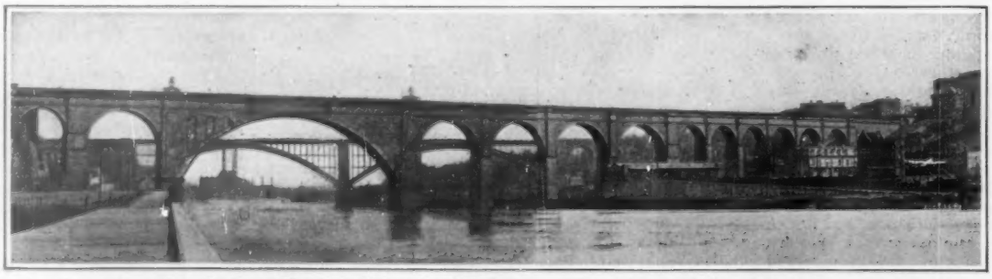


The most ambitious of the suggestions—a single long stone arch span to replace four of the present arches, leaving only one short arch over the river at the east (right) end

A triple-length span flanked at either end by one of the present arches



A single arch in the center of the river, replacing three adjoining units of the present bridge, and reducing the ones at either end to the level of mere ornaments



Another suggestion that would place the new triple span at the western side of the river, leaving two narrow arches over the water at the east

Alike on account of its historic interest and the part which it plays in the water supply—a part small under normal conditions but which might become vital in the event of emergency affecting the deep tunnel from the Catskills — the consensus of opinion is that the bridge should be preserved if possible, and in a form as closely approximating its present one as may be. The additional argument is made that there is no other bridge over the Harlem River between Central Bridge at 155th Street and Washington Bridge at 181st Street, a distance of over a mile. The reason for this is that the streets of Manhattan are separated from the river, throughout this distance, by an upstanding ridge of rock which forms the backbone of Morningside Heights, St. Nicholas, Colonial and High Bridge Parks. Along this particular interval from Central to Washington Bridges the configuration of the ground is such that no effort has ever been made to carry the lateral streets down to the Harlem River; and even on the Bronx side the situation is similar though hardly so extreme. It is argued that in remodeling High Bridge it could be provided with an effective roadway, which it now lacks, and an effective connection with the street system at both ends, which it lacks at the Manhattan end, where only foot-passengers can now leave the bridge.

With the positive action of the War Department, and all these considerations favoring a revision rather than a removal of the bridge, a good many plans have been put forward for eliminating one or more of the stone piers in the river which now support the bridge. Official opinion on the subject, however, has been very slow to make itself heard; and the photographs which we publish herewith are in fact the first public expression of what the responsible members of the city's engineering organization think of the problem.

These pictures are all from the official file of the city's engineers. They are all got up in the same way, by removing from a photograph of the bridge as it now stands the arches whose removal the particular scheme in question contemplates, and drawing in, in their place, the features of the new plan. Of these new plans there are, as will be seen, five from which to choose.

Getting a Line on Concrete Pipe

By S. R. Winters

WHEN 40 varieties of concrete pipe are being used for irrigation purposes, California alone supporting 150 concrete-pipe manufacturers, the demands for scientific information on the subject are not to be ignored. Strength, imperviousness to an incessant flow of water, and dependability are factors in an irrigation pipe system which insure the transformation of arid barrenness into flourishing areas of vegetation and people. The absence of these qualities may prove costly and retard man's progress in subduing an otherwise fertile territory.

Contractors, engineers, and irrigation managers are annually laying many hundred miles of artificial water routes, not without some trepidation, owing to the lack of specific information as to materials and methods entering into the manufacture of concrete pipe. Home-made equipment frequently isolated from the marts of trade, and a limited output are conditions which have heretofore kept standardization of the finished product in the background. Mounting prices of iron and steel, with a consequent enlarged use of concrete pipe in building irrigation routes, lend emphasis to the efforts of the Division of Irrigation of the U. S. Bureau of Public Roads in standardizing the methods of manufacture of the product.

Coöperating with the Department of Engineering of the State of California, the Federal government about twelve months ago established a field laboratory at Pasadena, Cal., where equipment has been devised and searching tests conducted. Progress in evolving equipment was slow, the machinery and methods being developed along original lines, and only recently were definite results available. The effects of quality of aggregates, grading materials for strength and imperviousness, quantity of mixing water, rock dust and improving water tightness, curing, amount of tamping, and comparison of strength of specimens tested dry and saturated were the angles of contact included in the experiments of the laboratory and yards of nearby factories.

The age-old method of testing the tensile strength of pipe was discarded by reasons of being cumbersome and costly, involving the disposal of huge volumes of waste water. Essentially, this antiquated method consists in the formation of a testing section composed of a number of joints of pipe of the desired diameter, bulkheading each end, the latter being secured by means of a connecting tie rod and then applying water under pressure to the interior until rupture ensued. Substituting therefore, F. W. Stanley and E. C. Fortier of the field laboratory of the Bureau of Public Roads, developed a plan of determining the strength of each joint separately without the use of bulkheads, the joint subjected to the test being influenced by no force other than the water pressure within its shell.

The newly-devised method of testing the tensile strength of the pipe is accomplished by use of a cylinder of galvanized sheet iron corresponding to the length of the pipe joint having grooves at each end, in each of which is inserted a small rubber tube resembling the inner tube of an automobile tire. The cylinder is placed inside the joint of pipe subject to testing and the rubber tubes are filled with water until they press tightly against the inner periphery of the pipe. Water is forthwith admitted into the small annular space between the cylinder and the inside of the pipe. Thereby watertight connections are insured with the same pressure in the tubes as exerted against the concrete pipe. The equipment is portable and can be readily conveyed from one concrete-pipe-manufacturing yard to another where stock pipe can be tested. Likewise the usual

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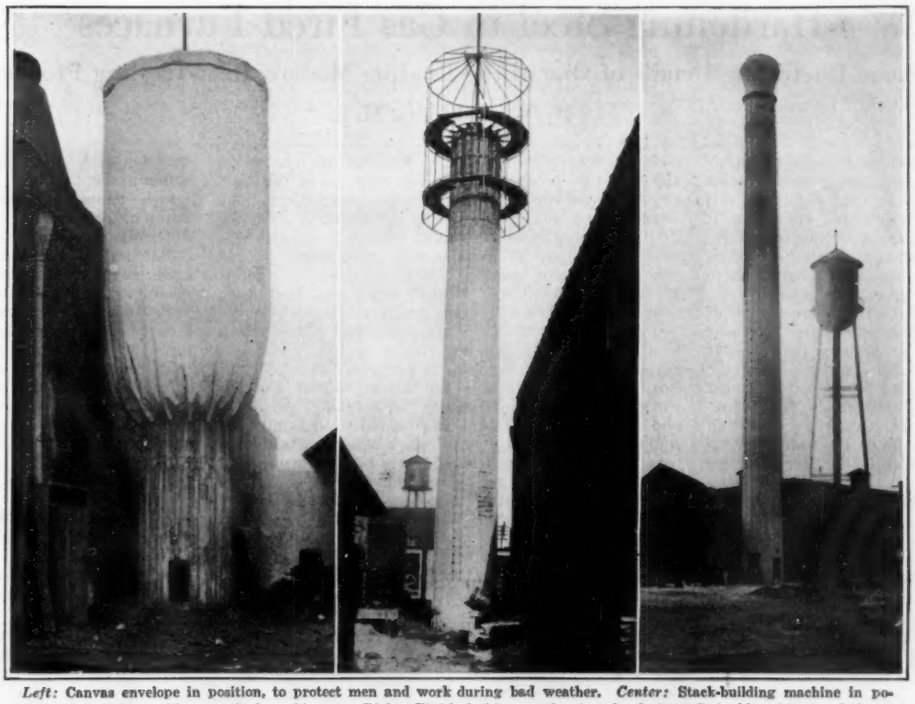

Left: Canvas envelope in position, to protect men and work during bad weather. *Center:* Stack-building machine in position for the ninth fill on an 80-foot chimney. *Right:* Finished chimney, showing the flutings that add architectural charm

Concrete chimneys of character, and how they are built

The Architecture of the Concrete Chimney

By G. Orb

IN line with the popular idea that coniform chimneys possess the most pleasing lines, a stack-building machine recently brought out not only adopts this style of architecture but it further ornaments the monolith with a series of vertical and integral ribs which extend the entire height of the structure, dying out in the base of the ornamental top. These ribs are half round in cross section and add strength as well as beauty to the chimney.

The machine used in this class of construction is really a steel cage, carrying the entire construction equipment, and the underlying principle of which is the steel center-mast. This center-mast, with a set of radiating steel tees, makes possible unusual accuracy in every line and absolute uniformity in the taper as the diameter decreases. The overlapping of the wall-forming shells, which are framed in small angles, takes care of this decrease in diameter as the height is increased.

At no time is there any scaffolding in use, either on the inside or the outside of the chimney, as the workmen use the construction ladder which hangs from the machine. A rib-forming corrugation is stamped in each section of the outer forms; and these forms may be readily removed when it is desired to place reinforcing, thus giving easy access to the work at all times.

The working platforms are carried by the machine itself—the supports of these being elaborated into the steel cage. If the weather conditions are unfavorable, a canvas envelope may be let down over the entire cage and the work proceeds unhindered, with complete disregard for temperature and precipitation.

Due to the rigidity of the machine and the ruggedness of its manufacture it is possible to use the much desired quaky and efficient, though heavy, concrete mix—thus requiring a minimum of materials.

A recently built chimney 5 feet in diameter at the bottom, tapering to 4 feet at the top and 100 feet high, was completed in twenty-one days by four men. The ordinary rate of construction is about six feet per day. The accuracy of construction and ornamentation, as well as the very great reduction in the cost, which the new quipment makes possible, will no doubt do much toward popularizing this method of putting up the big stacks so necessary in modern industry.

The equipment employed in testing of concrete pipe, and a test carried to the failing point

Hardening Steel in Gas Fired Furnaces

Some Interesting Details of One of the Leading Modern Heat-Treating Processes

By W. A. Ehlers, M. E.

PRACTICALLY all alloy steel used in the manufacture of machine parts and for other purposes where static and dynamic strength is required must have some form of heat treatment in order that it may possess the necessary strength, withstand vibrations, resist impact, have tortional resistance and good wearing qualities when two parts are in moving contact with each other.

This is very well illustrated in the manufacture of an automobile. The gears which are subject to wear must have hardened surfaces or abrasive hardness if they are to run smoothly. The springs must be flexible but not break. The steering mechanism must be very tough and free from brittleness. The crankshaft must withstand the impact of the connecting rods. The front and rear axles must be made to withstand the vibration and shock from the irregularities of the road, and in addition the rear axle must have tortional resistance to transmit the power from the rear transmission to the rear wheels.

Thus it may be said that a steel to meet the above requirements must have a high limit of endurance for the normal stresses and at the same time be able to withstand the abnormal stresses. It is a matter of experience to determine which quality in the steel must be given prime consideration. It also must be remembered that the heat treating process may entirely change the properties of the steel in their relation to the above-mentioned qualities.

Hardness is one of the properties of steel which is probably more often required than any other. It is that property by which the steel resists penetration.

The process of hardening is similar to that of annealing, except that instead of slow cooling, the steel is quenched quickly which causes it to become hardened. There are, therefore, two important operations in this process to be considered—the rate and ultimate temperature of heating, and the method of cooling.

In the hardening operation the same precautions are to be observed as in annealing, viz.: heat slowly and uniformly; do not exceed but slightly the upper critical temperature of the steel being heated. When the steel has thus been brought to the proper temperature the same transition has taken place as in annealing process, that is, the constituents have been changed into the hard structure known as austentite. Upon being suddenly plunged into the quenching bath while at this temperature, the rate of cooling is so sudden that there is little if any further change in the structure of the steel and it then takes the form of austentite, or if allowed to cool slightly it may change back to martensite or troostite.

One of the greatest mistakes made in the hardening room is in attempting to harden steel pieces of any considerable size such as dies in an open coal forge. It must be admitted without argument that such pieces cannot be evenly heated in such fires. Uneven heating will necessarily produce uneven cooling, which in turn will cause uneven strains in the steel, and result in hardening cracks. Gas heated furnaces for heating such steels are far better suited for the work since the rate of heating can be easily controlled and the uniformity of the gas heated oven is all that could be desired. Not only can a very uniform temperature be maintained in all parts of the furnace but the temperature of gas-heated furnaces is subject to positive and automatic control, thus eliminating any tendency to overheating which is very important in heating steels when approaching the critical temperature for that particular alloy.

Heating steels for ordinary hardening can be accomplished in several ways. The most general practice is to use oven furnaces for such work. When this type of furnace is used for high speed steel, the work should be preheated to about 1,100°F. and then placed in an oven having a slightly reducing flame, and a temperature ranging from 1,800° to 2,400°F. according to the character of the tool and the composition of the steel. There are, however, some classes of work which can be better handled perhaps in a liquid bath consisting of molten lead or salts. Small pieces such as typewriter and adding machine parts, spiral springs, cutlery, and long, slender tools such as drills and reamers may be handled better in such bath. This method will not only give uniform heating but there is less chance of overheating and oxidation. Lead, however, is expensive and therefore cannot very well be used for large pieces. It offers many disadvantages such as sticking to the parts immersed, and unless the surface is well covered with charcoal it volatilizes very easily and these fumes are poisonous.

To prevent lead from sticking to the work, cover the tools with a paste made of whiting mixed with alcohol, or dip them in a strong solution of brine.

Heating in salt solutions is very practicable and offers some advantages over lead. Pure table salt may be used, or mixed with chloride of potassium in different proportions and thus almost any predetermined temperature may be obtained. The melting point of the mixture may thus be used as a guide to determine the proper heating temperature.

Barium chloride baths are sometimes used for hardening high speed cutting tools. Its use however has been very much limited on account of the fact that very few operators know enough about handling it to have pronounced success. It consists of a salt melting at about 1,625°F. and is usually heated in furnaces with crucibles. The upkeep cost of such crucibles at the present time make this method almost prohibitive. One of the great advantages in this method of heating lies in the fact that tools having cuting edges do not suffer from oxidation as in other methods of heating, because on removing the tool from the bath a thin film of the solution adheres to the metal and prevents contact with the air. Work which is to be heated in barium chloride should first be preheated to a temperature of at least 1,000°F. before placing in the bath. Frequently this type of furnace is operated at such a high temperature (over 2,200°F.) that pitting of the steel occurs. This may be avoided by carrying out the hardening process at a lower temperature

The second operation of importance in hardening is the method of quenching. This not only applies to the kind of quenching bath but also to the way the part is handled in the bath.

Cold water, oil, and air offer the best means of cooling the steel. Air, however, can only be considered for such work where scaling is of no consequence or where the work can be ground after hardening.

Brine is used where extreme hardness is desired but unless unusual precaution is taken in having the work heated very uniformly this method is very likely to crack the steel.

Even plain cold water is very severe on the work and like brine may cause trouble on account of cracking. Yet for a great many classes of work this method is preferable. Steel ball bearings are an example wherein extreme hardness is desired and where water quenching is therefore preferable. A majority of the quenching is done in oil baths, particularly high carbon steels, and those used in places where the specimen may be subjected to considerable shock. Spring steel likewise should be quenched in oil. This method

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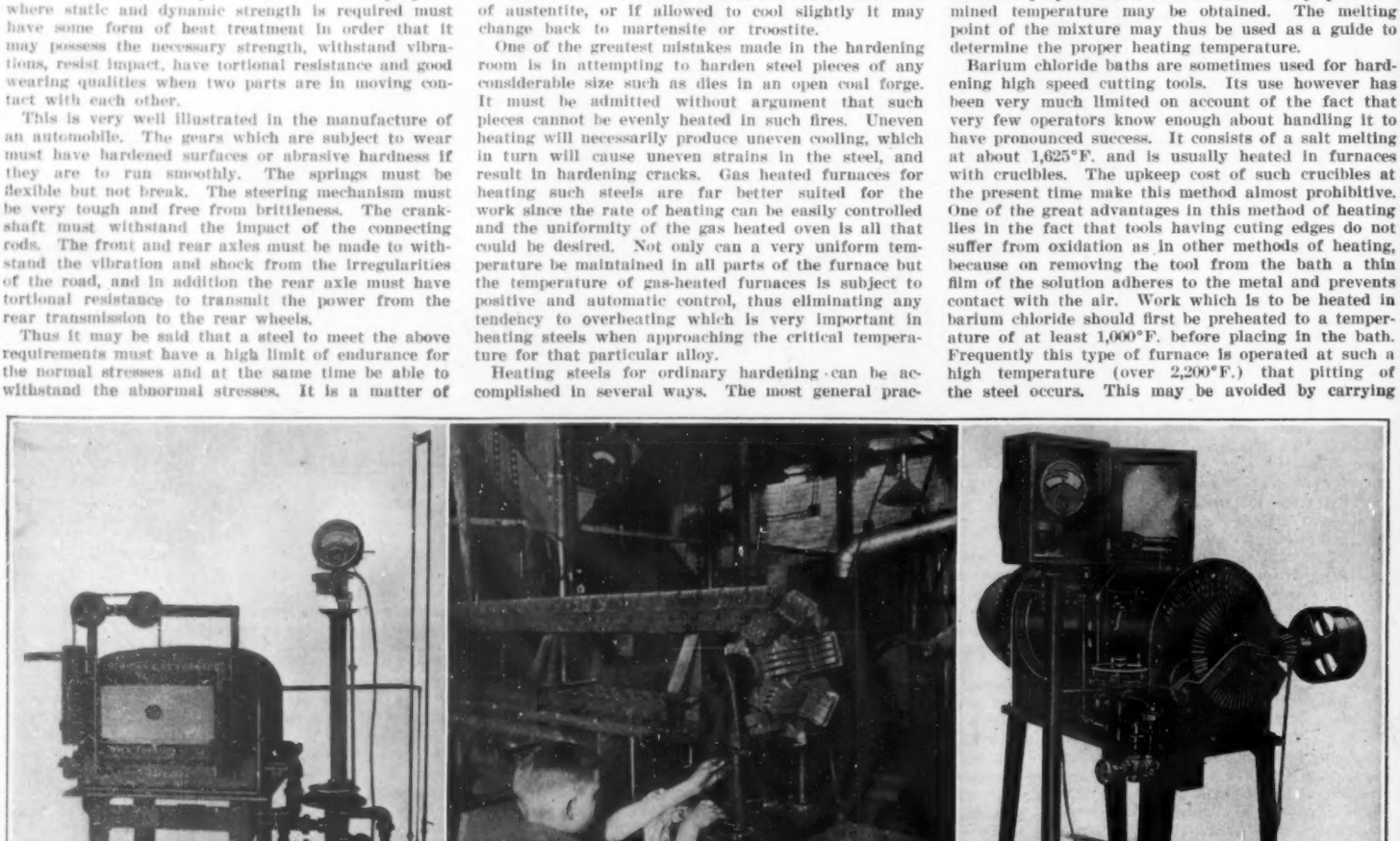


Left: Gas-heated oven-furnace, with automatic temperature controller. *Center:* Gas-heated automatic continuous hardening-furnace for pocket-knife blades. *Right:* Another type of hardening furnace with the automatic temperature control.

Some representative furnaces in which gas heat aids in the hardening of steel

The Last Race for the Gordon Bennett Cup

By John Jay Ide

THE Sixth Gordon Bennett Aviation Cup race took place near Etampes, France, on Tuesday, September 28th. It was won by Sadi Lecointe on a French Nieuport biplane equipped with a 300-hp. Hispano-Suiza engine. As this was the third consecutive time that the cup had been won by a French pilot it now passes permanently into the possession of the Aero Club de France.

The contest was held over a 50-kilometer course extending from the aerodrome of Villesauvage to La Marmogne. Three rounds of this course had to be covered, making a total of 300 kilometers (186.45 miles). On the previous Saturday a race of 100 kilometers to determine the three French entries had been held. This had resulted in the elimination of Casale (Spad) and Barrault (Borel), leaving Sadi Lecointe and Kirsch (Nieuports) and de Romanet (Spad) qualified.

To represent the United States the contest committee of the Aero Club of America chose one of the two Curtiss machines brought over by Mr. Cox, the Verville biplane entered by the Army Air Service, and the Dayton-Wright monoplane. The pilots of the American entries were Rohlfs, Captain Schroeder and Rinehart, respectively.

England was to be represented by a Sopwith biplane (Hawker), the Nieuport "Goshawk" (Tait-Cox) and the Martinsyde "Semi-quaver" (Raynham).

The Curtiss was wrecked in landing on the rough aerodrome at Etampes Sunday evening after flying down from Villacoublay where it had been assembled. The pilot, Rohlfs, was rather badly injured but was able to leave the hospital to see the cup race. Of the English entries the Sopwith never appeared owing to the collapse of the Sopwith Co. a few days before the race, and the Nieuport arrived too late.

The actual starters, therefore, were:

France—Sadi Lecointe (Nieuport, 300-hp. Hispano-Suiza); Kirsch (Nieuport, 300-hp. Hispano-Suiza); de Romanet (Spad, 300-hp. Hispano-Suiza).

America—Captain Schroeder (Verville, 600-hp. Packard); Rinehart (Dayton-Wright, 250-hp. Hall-Scott).

England—Raynham (Martinsyde, 300 hp. Hispano-Suiza).

During the morning the course was covered by a fog which did not begin to clear off until noon. It was thought for a time that the race would have to be postponed until the following day but after several test flights had been made it was decided that it could commence.

The French team had been taken out on the field at about 11 o'clock and had their motors tested, etc. De Romanet's Spad appeared with a new fin and rudder put on overnight, the old ones having proved too small for proper lateral control. While on the field the standard wheels of the Spad were replaced by those of the racing variety having tires and wheels completely enclosed in fabric casings.

The American and British machines were wheeled out of their hangars at about one o'clock. The former joined the French group on the field but the Martinsyde for some reason occupied an exclusive position about 300 yards away.

In the middle of the preparations for the start Tait-Cox arrived in a British Nieuport "Goshawk," bursting a tire on landing.

The first man to start in the race was Kirsch, who crossed the line at 1.36.25. He was followed by de Romanet at 1.44.52. Sadi Lecointe started at 2.8.54 and Rinehart at 2.11.10.

Great difficulty was experienced in starting the engine of Captain Schroeder's Verville and as the rules state that the contestant must cross the line within half an hour of the starting time he has chosen some anxious moments were passed by the American contingent. Finally the Verville got away just within the time limit at 2.37.2. The British contender did not leave until all other competitors had either finished or abandoned the race, waiting until 4.34.36 for absolute calm and cooler atmosphere.

Kirsch, the first starter, made the best time over the hundred kilometers (62.15 miles) which he covered in 21 minutes 29 seconds. Toward the end of the second lap, his engine began to miss and he abandoned the race after completing 200 kilometers (124.3 miles) in 48 minutes 52 1/5 seconds.

De Romanet ran a fine race against heavy odds. Near the end of the second lap an oil pipe broke, covering the pilot with lubricant. He landed at the aerodrome, made a hasty repair and took the air again, completing the race in 1 hour 39 minutes 6 3/5 seconds. De Romanet's time for 100 kilometers was 22 minutes 52 seconds and for 200 kilometers 46 minutes 7 seconds.

Sadi Lecointe, the French favorite, gave all spectators the impression of consummate skill. After taking off he flew around until he succeeded in obtaining perfect carburetion. Following this he rose to about 3,000 feet to pick out the most direct line to the other end of the course. He then descended to about 40 feet from the ground, crossed the line and in a few seconds disappeared on the horizon without, apparently, having deviated a foot from the course he had set himself at the start.

Lecointe's piloting on the turns aroused great enthusiasm. His system was to bank the machine several hundred yards before the line. Just before reaching it he would kick the rudder hard over, centrifugal force carrying him beyond the line in a turn approximating the vertical, the machine cutting the line again within three seconds. In less than a hundred yards the Nieuport would be on an even keel again speeding toward La Marmogne. The finishing line was crossed at a bare ten feet above the ground, the 300 kilometers (186.45 miles) being covered in only 1 hour 6 minutes 17 1/5 seconds, thereby creating a new world's record. The old record (2 hours 51 minutes 53 4/5 seconds) had been held by Tabuteau ever since January 21, 1912. Lecointe's time for 100 kilometers was 21 minutes 36 3/5 seconds and for 200 kilometers 43 minutes 42 3/5 seconds. Lecointe's time for 200 kilometers is also a new record, the old one having been made by Prévost in the last Gordon Bennett Cup race September 29, 1913 (59 minutes 45 3/5 seconds), also witnessed by the writer.

Meanwhile the two American entries had made very disappointing exhibitions, the Dayton-Wright having landed at the expiration of twelve minutes. It appeared that the top threads of the worm shaft controlling the hinged leading edge of the left wing (one of the novel features of this machine) had stripped causing the edge to flap when in the high speed position. This, of course, rendered the machine uncontrollable.

Captain Schroeder was forced to return when almost at the other end of the course on his first round due to motor preignition caused by insufficient radiator surface for the very warm day. The Verville gave an impression of tremendous speed and it is most regrettable that the enterprise of the Army Air Service in designing and in sending over this remarkable machine did not have a better reward. The design work has by no means been lost, however, as with a few alterations the Verville can be turned into a pursuit machine second to none.

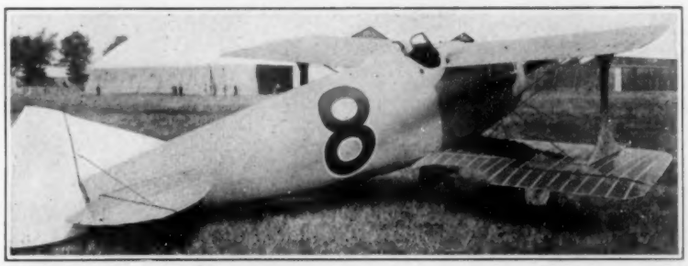
Raynham, who, as noted above, did not start until after half-past four returned to the aerodrome before he had completed 100 kilometers owing curiously enough to a similar mishap to that of the de Romanet—breakage of the oil feed. Raynham's Martinsyde is the identical machine which won the Aerial Derby around London last July. It is a smaller edition of the Martinsyde Scout—the fastest British single seater produced during the war.

The Spad entry was a standard model 20 with reduced wing gap and with a cover, carrying a fairing for the pilot's head, over the observer's cockpit. The performance of de Romanet therefore greatly redounds to the credit of M. Herbemont, the designer of the machine.

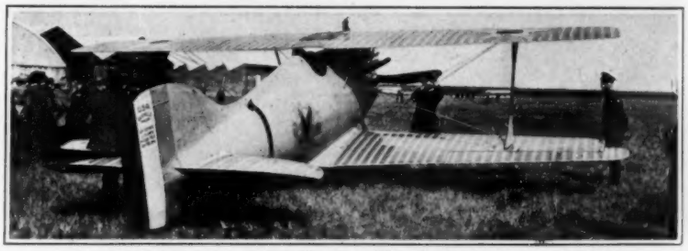
The Nieuport machines are a development of the model 29C1, which would have been adopted as the standard pursuit airplane by the French Army had the war continued. The Gordon Bennett models however are much smaller than the 29C1 type, having only one pair of struts on each side of the fuselage.

Nieuport biplane with 300-horsepower Hispano-Suiza engine, piloted by Sadi Lecointe, the winner of the race

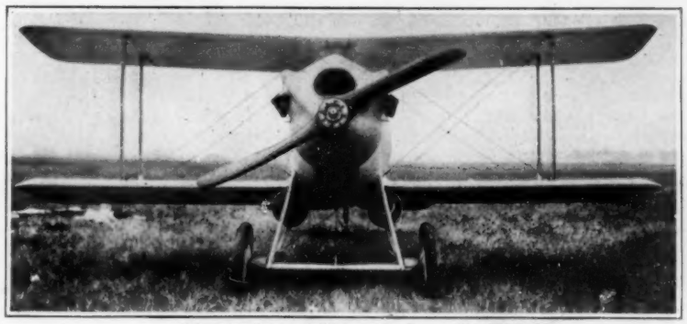
The American Dayton-Wright monoplane which was the most novel machine entered in the race



The Spad biplane of DeRomanet, showing enlarged fin and rudder. This machine finished second in the race



Another American entry, the Verville, showing changes in tail



Front view of Nieuport flown by Kirsch

The Heavens in November, 1920

Accumulated Data on the Distribution of Stars in Space

By Professor Henry Norris Russell, Ph. D.

A PAPER of more than usual interest has just been published by the Dutch astronomer, Kapteyn. For many years this distinguished student of the stars has devoted his unflagging energy and keen insight to the collection of information about the brightness, motions, and distances of the stars—all with one great purpose consistently in view: the determination of the structure of the stellar universe. How thickly are the stars scattered in space? What proportion of them is bright, and what fraction faint? Does the starry region extend indefinitely far in all directions, or is it limited and surrounded by relatively, if not quite, empty space? If so, what is the shape and size of the star-filled region? Is it sharply bounded, or does it thin out gradually at the edges? These, and questions like them, have been the problems to which Kapteyn has devoted his researches; and at last, after years of labor, aided by the codperation of observers at many places, and of skilled assistants, he and his associate, Dr. Van Rhij'n have found themselves ready to give out preliminary answers.

Space would fail us here to tell the tale of how these answers were obtained. Suffice it to say that the methods were mainly statistical—determining the number of stars in the sky which appear to us of each stellar magnitude; then finding out what percentage of the stars of each magnitude had proper motions between given limits; proceeding from this to estimate what fractions of the whole number lay at different distances from us—and so on—with a multitude of minor but still important and difficult problems coming up, now and again, which had to be solved before the main work could be completed.

The results, however, are easily enough understood. In presenting them here, we will translate the technical but unfamiliar terms "absolute magnitude" and "parsecs" into the more generally familiar ones of brightness compared with the sun, and distances in light-years.

Our Sidereal Neighborhood

Within a hundred light-years of our sun, the stars appear to be scattered with fair uniformity in space. The number which lie within this distance, according to Kapteyn's new calculation, is 6,200. If we limit ourselves to half the distance, we should expect to find, not half as many stars, but one-eighth as many, since the region in space within which we are looking for them is a sphere with only half the diameter of the one we had at first, and hence contains only one-eighth as many cubic light-years. Only one in a thousand of the 6,200 stars should be within ten light-years of us—that is, six in all. Four stars are actually known to be nearer than this—Alpha Centauri, Sirius, Barnard's "runaway" star, and the seventh magnitude star known as Lalande 21,185; and two or three others are so near the limit that we can hardly say whether they are inside or outside it. Then we must not forget the sun itself, which is a star essentially similar to the others; and so we have in all six or seven stars within this region of space, in perfect agreement with Kapteyn's calculations—though in the case of so very small a sample of space, so close an agreement is probably a matter of good luck.

But even among these nearest neighbors of ours we find enormous differences of real brightness. Sirius is more than twenty times as bright as the sun; Barnard's star gives out only 1/2500 of the sun's light. How is it among the stars in the wder field which Kapteyn has made his own?

His calculations show that a surprisingly definite answer may now be given. The great majority of stars in any given region of space are fainter than the sun, and really bright stars are rare. For example, out of the 6,200 stars nearer than 100 light-years, 790, or only one-eighth of the whole number, may be expected to exceed the sun in brightness. About 100 of these will be ten times as bright as the sun, or more; and only five or six will exceed 100 times the sun's brightness. Only one star in 50,000, on the average, is 1,000 times as bright as the sun, so that we would not expect to find such a star as near as 100 light-years. We can be sure that there is actually none, for at this distance a star 1,000 times brighter than the sun would look to us brighter than Vega. There are only three stars in the sky brighter than this. Two of them, Sirius and Alpha Centauri, are very near us and of moderate real brightness; the third, Canopus, is certainly more than 1,000 times as bright as the sun and certainly more than 100 light-years away.

But we have said nothing yet about the stars fainter than the sun, though these constitute the majority of the whole—5,410 out of the 6,200 stars aforesaid. About 3,400 of these will give out less than one-tenth as much light as the sun, leaving some 2,000 in the intermediate region of brightness; and of the 3,400, 2,200 will be found to possess a luminosity between ten per cent and one per cent of the sun's.

Among the remaining 1,200 still fainter stars, objects of very small luminosity appear to become rare. Some 200 of them are less than 1/1000 as bright as the sun. Our information about these very faint stars is still scanty; but according to Dr. Kapteyn's present data, only a dozen will be less than a ten-thousandth of the sun's brightness.

At 11 o'clock: Nov. 7.
At 10½ o'clock: Nov.14.
At 10 o'clock: Nov. 22.

At 9 o'clock: Dec. 7.
At 8½ o'clock: Dec. 15.
At 8 o'clock: Dec. 23.

At 9¼ o'clock: November 30

NIGHT SKY: NOVEMBER AND DECEMBER

Some Apparent Paradoxes

According to this census of the stars, we may therefore regard our sun as a pretty bright object, surpassing seven out of eight of his fellows. But how are we to reconcile this with the fact—demonstrated securely by direct measures of parallax—that the majority of the brighter stars in the sky are much more luminous than the sun? This apparent paradox arises because the stars visible to the naked eye—or, for that matter, above any assigned limit of *apparent* brightness—are not a fair sample of the whole, but are hand-picked (or it would be better to say *eye-picked*) to an amazing degree.

Let us compare, for example, the stars which are between 10 and 100 times brighter than the sun with those which are between 10 and 100 per cent of the sun's brightness. We found above that there were 2,000 of the latter class within 100 light-years of us, as against a little less than 100 of the former—a disparity of twenty to one. The stars of the brighter group, even if at the limiting distance, would *all* be easily visible to the naked eye as stars of the fifth magnitude or brighter. But those of the other group, if at a distance of 100 light-years, would appear as stars ranging from the seventh to the tenth magnitude, and so would not get into our list of naked-eye stars at all. Only a few of them, which are less than twenty light-years away (or ten light-years, for the faintest members of the group) will be easily visible to the naked eye; and these will be but a beggarly fraction of the whole number.

Speaking more generally, the stars of the first group, on the average, are 100 times as bright as those of the second. We can therefore see them at ten times the distance, and we will be hunting for them throughout a region of space a thousand times greater than that to which our search for stars of the other group is limited.

For every star of the fainter sort which gets into our list of naked-eye stars, there will therefore be fifty stars of the brighter kind—and a thousand of the fainter sort which, though no farther away from us than the brighter ones which we have listed, are invisible to the naked eye.

This thousand-to-one preference, converting a real minority of five per cent into an apparent majority of 98 per cent, is not at all an exaggerated example of the effects of observational selection. In some cases, as between stars like Vega and Arcturus and objects like Barnard's star, the preference would be a million to one—so that it is not surprising that only one isolated star as faint, in reality, as Barnard's has been discovered among the half-million or so stars brighter than the tenth magnitude.

Closely allied with this effect is another curious and half-paradoxical fact. The total amount of light given out by the 6,200 stars which we may, by stretching our definition of neighborhood somewhat, call our neighbors in space, comes out 6,500 times the sun's light; so that the average amount of light given by one star is very nearly equal to that of the sun. But a simple calculation shows that 87 per cent of the stars, which are fainter than the sun, give out only 12 per cent of the total light, the remaining 13 per cent giving out 88 per cent of the total. The stars which are more than 15 times as bright as the sun, though numbering only one per cent of the whole, give out half of all the light. Such considerations illustrate what extraordinary differences will appear in our point of view and in the results which we obtain, according as we count the stars as they appear in the sky, or measure them by their light-giving power. The novice will find many pitfalls in such statistical studies, and even the well-equipped student, if not explicitly on his guard, may be caught. It need hardly be added that such effects have been very carefully allowed for in Kapteyn's monumental work.

The Heavens

Turning to our star-gazing, we find Orion high in the southeast, with Sirius below, Aldebaran and the Pleiades above, and Procyon on the left. Perseus and Auriga are overhead, Gemini high in the east, and Leo rising. Ursa Major is low in the northeast, and Ursa Minor and Draco in the north. Cassiopeia is high in the northwest, and Cygnus is setting far below. Pegasus is well up in the west, with Andromeda above. Cetus and Eridanus occupy the great dull region in the southwest.

The Planets

Mercury is an evening star before the 16th, and a morning star afterwards, but is visible only at the very beginning and end of the month. Venus is an evening star, but is still very far south, and sets before 8 P. M. Mars is an evening star, too, and sets about an hour and a half after Venus.

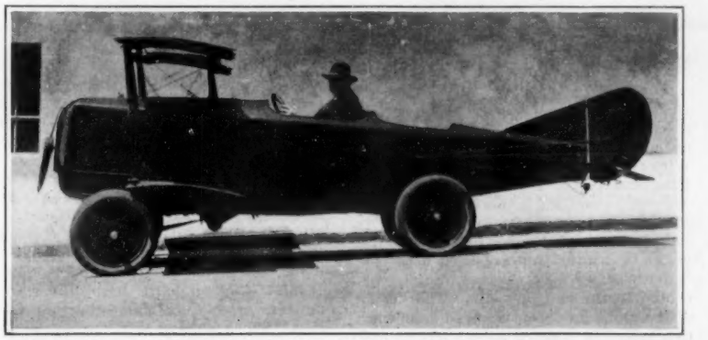
(*Continued on page 460*)

An Airplane Not Built to Fly

THE accompanying illustration shows an airplane built on a light car chassis by a San Francisco automobile company. The machine is used as a stunt; that is to say it is an advertising car and not a flier.

The propeller of this novel airplane that never leaves the ground may be operated from the engine of the car if desired. The machine is built exactly on the lines of an airplane, being provided with rudder and elevators, the rudder being connected with the steering wheel by means of cables in such a manner that the rudder turns to the right and left as the steering gear is manipulated, thus acting as a direction indicator to the motorists in the rear.

The elevators are operated by the controlling lever as in an ordinary plane, and when the car is brought to a standstill the elevators are lowered in the same position as on a plane when descending. The car is equipped with airplane tires with special tread in the rear to conform with the narrowness of the body toward the rear. The car carries port and starboard lights controlled by a switch. The car is a two-seater.



This is not an airplane; it is a light automobile with something new in the way of a freak body

A Ferryboat Built on Motor-Boat Lines

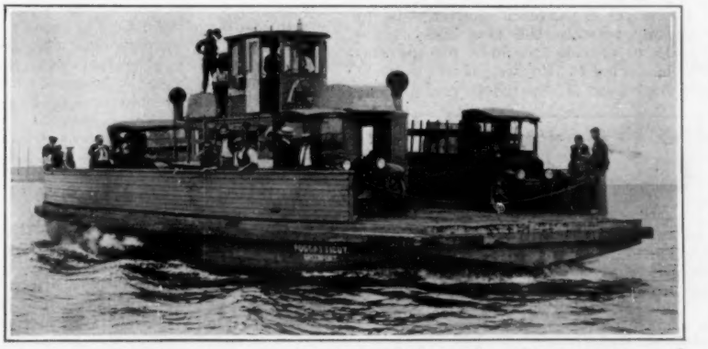
BECAUSE of the limited traffic to be handled, a gasoline engine is being used in connection with the ferryboat "Poggatticut," which operates between Greenport and Shelter Island Heights, at the eastern end of Long Island, N. Y. This boat makes round trips twice an hour, accommodating eight automobiles on uncovered runways alongside the central passenger cabin. Licensed for one hundred passengers, she is operated by a gasoline engine and a two-man crew consisting of the pilot-engineer and a deck hand. Truly, this is economical operation and quite in keeping with the limited traffic.

The "Poggatticut" is 64 feet long, 28 feet overall beam, 4 feet 11 inches draft loaded, with a gross tonnage of 72.6 and a net tonnage of 57. This ship is constructed with straight floors from keel to bilge corners, with the fore and aft treatment carefully worked out. Indeed, she makes scarcely a ripple when traveling at eight miles per hour.

The operation of the ferryboat is entirely from the pilot house, which is equipped with engine and clutch controls. This house is directly connected with the engine room by a vertical ladder shaft with a sliding door opening to main deck runway, and has a door on each diagonal side to the boat deck where two wooden ponts, equipped as life boats and totaling the required life-boat capacity, are checked bottom up.

The power plant is extremely novel, comprising an automatic 50-horse-power double flywheel engine, with a one-way clutch at each end connecting to the continuous-line shafting with a propeller at each end. The forward propeller runs idle while the boat is being driven forward, but comes into play when a reverse action is wanted. The rudders are fitted with locking pins and protected by an armored ram for operation in ice of reasonable thickness.

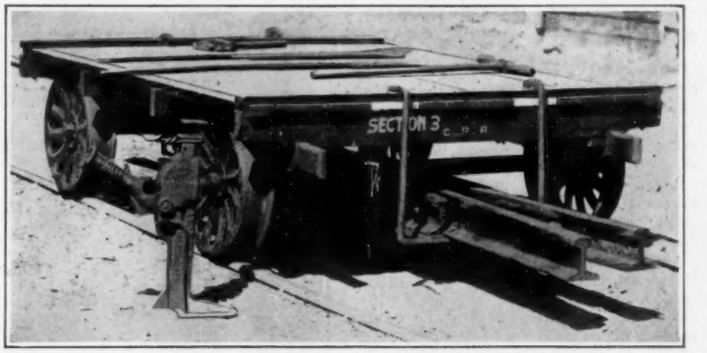
The remarkably steady running and maneuvering qualities of the "Poggatticut" are its strongest talking points, since the heavy tides encountered on her route call for an extremely manageable craft.



The "Poggatticut"—a two-man ferryboat which carries 100 passengers and eight automobiles

Loading Rails With a Jack

THOSE who have to do with the handling of lumber have, in many instances, discovered that these shapes, long and narrow to the last degree are frequently best manipulated with the aid of an underslung carriage of some sort; and the SCIENTIFIC AMERICAN has on several occasions described and pictured such appliances. A new member of the family now comes to our attention, the invention of Mr. Arthur Vinet of Winnipeg. This time the intent is to facilitate the handling, not of lumber, but of another shape equally long and if anything even narrower—railroad rails, frogs, etc. It will be noted in the picture, which really tells the story of Mr. Vinet's invention, that the hooks forming his underslung carriage are not a permanent feature of the flat car on which they are installed, but that they can be removed from and added to the car almost as easily as the rails can be loaded on and unloaded from the hooks themselves. The procedure for loading, after placing the rail or frog to be loaded in the center of the track, is to run the car over it, put a track-wrench through the bolt holes at either end of the piece to be loaded, jack up the ends of the frog until it reaches the axles of the car, and then place the hooks. The idea has proven so good in practice that Mr. Vinet's invention has been installed in the Canadian Pacific terminals throughout Canada.



The temporary underslung carriage on which rails can be loaded with no other tool than a jack

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Paint racks on roof of Chemistry Building of the Bureau of Standards at Washington, D. C.

Where Age Improves Germination

THE seed of some garden vegetables is never saved by amateurs for the reason that the plant is a biennial, and doesn't make seed until the second year. Cucumber seed is seldom saved probably for another important reason and that is the germination factor. Cucumber seed only a year old is characteristically poor seed. Germination improves with age. Seed houses never plan to sell cucumber seed which is not at least two years old. Seedsmen, as the professional gardener is perfectly well aware, know that cucumber seed is at its best at three years; that it is excellent at five years. Not only does aged cucumber seed have higher germination, but it produces much stronger plants. Plant cucumber seed fifteen or even twenty years old, and a great deal of it often will come up.

As in the case of cantaloupes, the cucumber seed business of the United States is largely in the hands of expert growers who control large acreages. Some of the big growers have as much as 200,000 lbs. in storage at one time. The warehouse is mouse-proof and fire-proof, and so that they may guarantee seed free from disease the cucumber specialists disinfect it.

Here, as in many other fields of agriculture, constant experimental work is the price of progress. Corrosive sublimate is the agent used in treating seed. In doing this for a long time many growers dissolved the poison in cold water until an expert showed them that either hot water or wood alcohol must be used to make the solution. Corrosive sublimate "dissolved" in cold water simply sinks to the bottom.

Another little point that had to be worked out was the strength of the solution. The proper percentages of corrosive sublimate, it has been determined, is 1-1,000. A proportion of 1-200 will kill all the seed, 1-400 most of it, 1-600 some, 1-800 a little.

Rinsing the seed is an operation which has led to ingenuity. Formerly the practice was to rinse it for a long time in running water; most growers do now, in fact. One of the largest operators introduced a better method. He uses a little lime water, and the work of rinsing is radically reduced.

Putting Paint to the Acid Test

THE untiring Bureau of Standards has recently undertaken to test paints on a scientific basis; or, in other words, to take the guess work out of paints. For paints are used as much or even more for preservative purposes than for decorative purposes, and something definite should be known in advance regarding the wearing qualities of any paint.

A series of racks has been erected on the roof of the Chemistry Building of the Bureau of Standards, as shown in the accompanying view. On these racks are placed slabs or panels of wood and metal, coated with the paints and varnishes to be tested. The slabs or panels are exposed at an angle of 45 degrees to the vertical facing south so as to get the most severe exposure. In this manner the paints and varnishes are subjected to the most extreme conditions that would be encountered in normal use, and the experts of the Bureau are enabled to gage with considerable accuracy the wearing qualities of various paints and varnishes. Not only does the Bureau test the samples submitted by manufacturers, but the very elaborate paint shop of the Bureau is carrying on important research work in the way of guiding all efforts toward better paints and varnishes.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

A handy tool for the repair of unwieldy truck tires

Electric Buffer for Truck Tires

A HANDY tool for shop or garage use in repairing truck tires is the equipment shown here. The equipment consists of bench stand with flat pulley, five feet of shafting, spindle and scratch brush. The equipment can be driven from the line shaft or from a motor as shown. It is said to do efficient and economical work.

Trunk with an Ironing Board

WARDROBE trunks were thought to be the last word in traveling equipment when they were first introduced a few years ago. The various compartments for wearing apparel were then as convenient as the makers knew how to make them. But a 1920 model wardrobe trunk made by a Chicago manufacturer would make the old models shiver with shame. The newer trunks have made use of the pressure board, used to keep the wrinkles from garments hung upon the hangers, as an ironing board combination. This board, used formerly for but one purpose, now serves two. Upon one side it is padded and has the outer end rounded so that the owner can easily press the shoulders of shirts or blouses. The firm foundation is possible because of the upright support which clamps to the outer end.

Various other improvements are also found in the trunk, such as collapsible hat boxes, shoe compartments, electric iron space, umbrella and cane rack, not to mention an improvement in locking. By a single motion of the hand on the top locking device, two other locks located below are secured at the same time. This eliminates stooping over to fasten the lower locks.

A wardrobe trunk equipped with an ironing board

Light and Power from a Single Bulb

A TWO-BASE incandescent globe has been designed by E. O. Schmeitzer, an electrical engineer of Chicago, Ill. With this globe it is now possible to have light and power from the same socket without connecting a double base socket. The new globe is simply connected in the old way and any heating device that might be wanted for use such as a cold water warmer, electric iron, etc., is connected to the end opposite. The design of the globe has been changed somewhat to a cylindrical shape with a tipless end. The exhaustion of the bulb has been carried out by means of a sealed-off tube concealed within one of the bases. The lead wires are given a quarter twist in passing between the two ends of the lamp to provide clearance for the filament anchors. Old designs of electrical devices used in the home can now be

The lamp that gives light and power at the same time, auxiliary apparatus being connected at the "other end"

quickly and cheaply changed to provide more harmonious lighting effects. What is known as a "pendant" fixture can be converted into a semi-indirect fixture by the use of the new lamp.—By *K. H. Hamilton.*

New Sources of Power Alcohol

THE opinion gathers force that there are ample sources of the raw materials of power alcohol available in regions where the difficulties in connection with the transport of plant and machinery required and of the product to the consuming centers are not so great as in some of the areas which have been marked out as ideal raw material producers, according to the *Times Trade Supplement.*

It is reported that in the Pacific Islands alone, maize, cassava and sugar cane could be grown and utilized to an extent which should produce 50,000,000 gallons a year, and it is suggested that the world demands could be filled by the raw material available within certain Empire areas. Estimates of the cost of obtaining industrial alcohol from the crops named indicate that 6d. per gallon is a figure which could be realized, and the process of distillation should be associated with the recovery of valuable by-products.

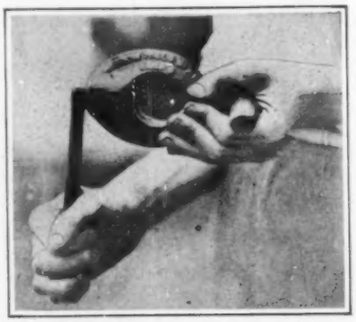
Floating Fair from the Netherlands

A COMPANY has been organized at The Hague for the purpose of sending a "floating fair" as it is called, but practically a ship loaded with sample products and commercial agents to sell them, to various parts of the world, particularly the United States. The concern is organized somewhat on a coöperative basis and proposes to send the Messageries Maritimes vessel, the "Macedonia," of 6,100 tons burden to the United States and Central and South America for the purpose of introducing Netherlands products and enabling Netherlands commercial houses to establish import and export connections in the countries visited.

The plan is for each of the Netherlands firms going into the scheme to advance the sum of 2,800 guilders or, at present exchange, the equivalent of $861 American currency, for each cubic meter of space occupied aboard the vessel by an exhibitor and 200 guilders or about $61 gold for each port visited. The ship will be divided into show rooms and each exhibitor will instal aboard the vessel in the space he engages such a display of his goods as he cares to make and will furnish the company with advertising matter, price lists, and other information. The company will furnish an organization of commercial men on the ship which will act as sales agents and will endeavor to arrange satisfactory permanent connections for the exhibitors in the ports visited. For sales actually made the company will charge a single commission of 10 per cent, taking no commission on the business which follows from connections thus made. It proposes to carry on a comprehensive advertising campaign in the countries to be visited so as to secure the maximum result from the visit.

New Lathe Dog with Safety Feature

A LATHE dog being manufactured by an Ohio firm is fitted with a recess into which the set screw head fits and the danger of breaking projecting set screws is eliminated. Extra metal used in forming the recess serves to balance the dog. The screw of the dog is set with a socket wrench.—By *Allen P. Child.*



Setting the screw of the safety lathe dog with a socket wrench

Restoration of the Belgian Railroads

TRADE COMMISSIONER SAMUEL H. CROSS reports from Brussels, Belgium, under date of August 25, that the severely damaged railroad section from Mons to Ghlin has been completely rebuilt, and the bridge over the Lys just outside the St. Pierre station at Ghent has lately been opened for double-track use. The Alost-Opwijk-Londerzeel and Dixmude-Nieuport lines are nearly ready for operation, while the Courtrai-Menin line is open as far as Warneton. Interlocking block systems have been installed between Brussels and Antwerp and between Brussels and Ostend. A similar system is in process of installation on the Namur-Sterpenich route. Purchases of equipment are being made for the restoration of the electric switch systems in the larger stations. The central shops are repairing 12 locomotives per week, as against 19 in 1914, while the section shops have reached 50 per cent of their pre-war efficiency.

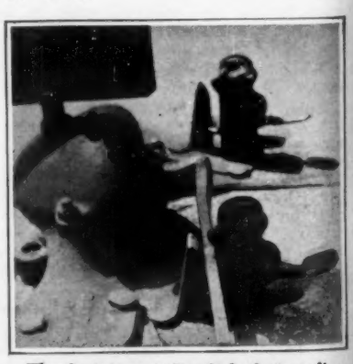
To protect the cotton-picker's fingers

Finger Guard for Cotton Picking

ONE of the latest inventions for use in the cotton fields is a very simple cotton picker, consisting of a piece of flexible metal that is adjustable to fit the finger. It fits securely over the first joint of the finger, one to each finger. On the inside it has five small cleats to give tenacity. Experienced pickers declare that with a set of these pickers they increase their capacity from twenty to fifty per cent. The inventor is A. A. Ross of Oklahoma City, a practical cotton picker himself. With the labor shortage this picker is bound to prove popular throughout the cotton States. In addition to increasing the capacity of the worker, it also prevents pricking of fingers on cotton burs, a frequent and trying accompaniment of cotton-picking under the usual procedure.

Throwing a Switch with the Foot

THE new San Diego and Arizona Railway has installed some foot-operated switches that make the life of the brakeman much easier and at the same time prevent a switch from throwing itself in the jar of a long freight train's passing over the rail intersection. When the arm operating the switch is thrown, it falls under a spring catch, from which it cannot emerge until the catch is opened by the foot lever seen in the picture. It is thus additionally safe and at the same time the brakeman finds it much easier and speedier than when he must put a pin in place after throwing the switch to hold the switch from jumping open.—By *Frank R. Howe.*



The foot-operated switch that can't be jarred open

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Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farming Implements, Etc.

Pertaining to Apparel

DRESS SHIELD.—HELEN WEEKS, 216 W. 140th St., New York, N. Y. The object of the invention is to provide means whereby a dress shield may be quickly, conveniently and securely attached to the dress without resorting to sewing or to the use of safety pins. Another object is to permit of readily attaching or detaching the shield without its being visible through the garment or without requiring alterations thereof.

Of General Interest

OPENER FOR GLASS TOPPED JARS.—D. C. RELYEA, Coscob, Conn. This invention relates to kitchen utensils and has particular reference to manually-operated means for opening glass-topped fruit jars, which are usually held sealed by external atmospheric pressure. Among the objects is to provide an implement which will serve two conditions, first the admission of air into the container for relieving the external pressure, and secondly a device which is least likely to cause the cracking, chipping or breaking of either the glass top or the rim.

WINDOW ATTACHMENT.—J. E. GALBRAITH, 20 W. 14th St., Whitestone, L. I., N. Y. This invention relates to an attachment more especially designed to cover the opening between the top rail of the lower sash and the upper sash to prevent insects, dust, snow, etc., from entering the room by way of the opening. Among the objects is to render the attachment serviceable in case the lower sash is raised to insert a screen in the lower portion of the window casing. The device may be adjusted to windows of different widths.

GATE CLOSER AND SUPPORTER.—R. P. BELLICAN, Natches, Miss. An object of the invention is to construct a device which will act as a supporter and closer for closures, and more particularly gates, by means of which the gate will always be properly closed, the closer also acting as a supporter for the gate as well as a hinge, thus tending to control the life of the closure and to eliminate adjustments and repairs to a minimum.

SOAP CONTAINER.—E. O'CONNOR, 166 Market St., Newark, N. J. This invention relates particularly to soap containers adapted to form a part of a douche or internal bath device, which compels the water to pass through the soap to render the water soapy and supply such soapy water in such quantity as may be desired.

ALLOY.—F. MILLIKEN, 55 John St., New York, N. Y. The object of the invention is to provide an alloy characterized by having a high acid-resisting quality, and increased density, an exceedingly close and fine grain, great tensile strength, increased elasticity, and electrical resistance. The alloy is formed of copper 50-60 per cent, nickel 26-34 per cent, iron 4-8 per cent, zinc, 7-11 per cent, and a deoxidizing or purifying agent, 25 to 5 per cent.

BED.—R. F. HELLWEG, 3660 Douglas St., El Paso, Texas. This invention relates to improvement in beds, an object being to provide coupling means between the side rails of the bed and the head of the bed which will permit the rails to be located either in position to support a spring or to support slats and to facilitate this double function, the side rails are of the ordinary angle iron form.

CHECK BOOK ATTACHMENT.—W. E. ABNOTT, Bend, Ore. An object of the invention is to provide a folding check book with a check clamp slidably engaging the checks and movable to a position across the field of the check so as to hold the checks smoothly while drawing the same, and which can also be moved into alinement with the division line between the check and stub, and operate as a straight edge against which the check can be torn.

SALT AND PEPPER BOX.—W. R. ELLIOT, Fairfield, Conn. This invention relates to salt and pepper boxes, having for its object a construction wherein separate salt and pepper receptacles may be supported by a single holder and controlled by a single cover so that only one box will discharge at a time. The two boxes are substantially duplicates with coacting means for holding a single movable cover in place adapted to stop the flow from either box.

GUN SIGHT.—E. E. GREGORY, Lewisport, Ky. The invention has for its object to provide a sight adapted for any form of gun, and so arranged that by using the sight with both eyes open the range will be automatically found. Two images of sight are formed when the marksman looking along the top of the gun barrel focuses his eyes on the target. These images appear transparent and in overlapping form an opaque central pyramidal image, the apex of which determines the point which should rest upon the target when the trigger is pulled.

BELL.—A. ROY, Hill City, So. Dak. The object of the invention is to provide a bell adapted to be attached to keys, as for instance, the keys of hotel rooms, for indicating with an audible alarm when the key is tampered with, by attempting to turn it from the outside, and which will also sound while the key is in the pocket through the movement of the carrier, thus preventing its loss.

BASKET.—G. L. O'DELL, 323 W. May St., Belding, Mich. The invention relates more particularly to an unwoven and unbraided, splint basket, although in all its phases it is not limited to baskets of that particular character. The general object is to provide a basket to be produced cheaper than braided baskets, and one which will give a better service.

DRIER TRAY.—C. E. JOHNSON, Boundbrook, N. J. The invention relates more particularly to trays used for the quick drying of dyes, paints, colors, chemicals, etc. An object is to provide a tray made of one sheet of metal bent into a shape such that a maximum drying surface will be exposed to the material to be dried and provide a plurality of passages which allow a free circulation of heated air.

DRINKING CUP HOLDER FOR WATER BOTTLES.—C. ROSENTHAL, 19 E. 9th St., New York, N. Y. The invention relates particularly to a device adapted to clamp upon the inverted upper end of a water bottle when the latter is in position in a water cooler, an object being to provide a device which will effectually support a carton or box containing a column of drinking cups in convenient position for use.

GROUND ANCHOR.—I. SOLBERG, 125 W. Stout St., Rice Lake, Wis. An object of the invention is to provide an anchor which will take a firm hold in the ground and which may be utilized for drawing an automobile out of a dangerous position, and which, of course, may be utilized for any other purpose wherever a rigid support is desired. A further object is to provide a ground anchor, which, when not desired for use, can be assembled and occupy but relatively small space.

WICKER PANEL.—W. H. STOCKER, 721 Lombard St., Philadelphia, Pa. The invention relates to panels of ratan, reed, willow or like material, and is adapted to be variously employed in the construction of furniture such as tables or chairs, or in building up walls or portions of walls. The general object is to provide a panel embodying frame elements and woven areas which will be strong and durable and will possess esthetic attributes to a high degree.

DRIP CATCHER FOR REFRIGERATORS.—A. B. BATES, c/o Genl. Deliv., Balboa Heights, Panama Canal Zone. The invention relates particularly to drip catchers for refrigerators, the object being the provision of a porous material arranged for catching the drip, which will obviate the removing and emptying of pans now commonly used for the purpose, the construction of the catcher effecting an evaporation of the waste water and in this way avoids the necessity of its removal.

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The Problems of Electrification

(Continued from page 444)

ative costs show great economies. Another electrified western line is handling trains of 4,600 tons at a speed 20 per cent higher than was possible with steam traction and a limiting load of 3,500 tons.

Here in the East, down in a mountainous part of West Virginia where there is an extensive movement of coal from local mines, a railway formerly operated entirely by steam, now handles double the capacity on a certain section with 12 electric locomotives where it used to employ 33 great Mallet engines. The grades are extremely heavy, and yet, on the stiffest of these, trains of 3,500 tons are dealt with without trouble, and are moved about 100 per cent faster than when steam locomotives did the work. In fact, in numerous instances throughout the country, it is no uncommon thing to maintain electrified freight speeds of 15 miles or more an hour where formerly steam traction was limited to 6 and 8 miles. Thus we see how entirely feasible it is not only to reduce the bottle-necking condition but, at the same time to increase the loads which can be hauled by a single engine.

As is pretty generally known, several different systems of railroad electrification have been developed, each with its own particular claims to consideration. For the most part the lines so operated are not interrelated, and each typifies a more or less distinct step forward in the art; and as may be imagined each has its advocates. At present three lines focusing in the City of New York are using direct current of 600 volts, distributed by third rail. In effect this is an expansion of trolley practice to the main-line field—the third rail providing a conductor of sufficient volume to handle the heavy low-voltage current. Aside from complicating yard lay-outs and inviting numerous troubles, this arrangement is not suitable for long distances.

For trunk-line work, where the runs are of considerable length, we have naturally had recourse to trolley wires and high-voltage current in the distributive systems, and we have resorted to both direct current as well as single-phase alternating current on the roads concerned. The direct-current service has successively jumped from 1,500 volts to 2,400 volts, and then to 3,000 volts on the greatest electrified stretch in the country. But in order to obtain efficient primary distribution of energy from the power stations, alternating current of 100,000 volts is depended upon. This feeds to seven or more sub-stations along the route, where the alternating current is transformed to direct current of 3,000 volts by means of motor-generator sets installed at these points. As may be imagined, these sub-stations are necessarily complicated and extensive in their equipment.

Single-phase alternating current systems are in service in connection with a number of important roads in the East, where they are handling the varying demands of express and local passenger traffic and dealing efficiently with fast and slow freight on both fairly level and mountainous runs. Instead of motor-generator sets, as in the case of direct-current sub-stations, the transforming work is done by static transformers with no moving parts.

Similarly, where the overhead wires carry a much higher voltage than is needed for the operative motors of the electric locomotive or the multiple-unit train, small static transformers on either the locomotive or the cars meet every requirement. Structurally, they are of extreme simplicity, and besides are automatic in their functioning. High-voltage alternating current can be distributed farther, more efficiently, and by smaller conductors than is practicable in the case of direct current.

For multiple-unit operation, which must inevitably be counted upon to handle local passenger traffic in and out of populous centers, alternating current is preëminent-

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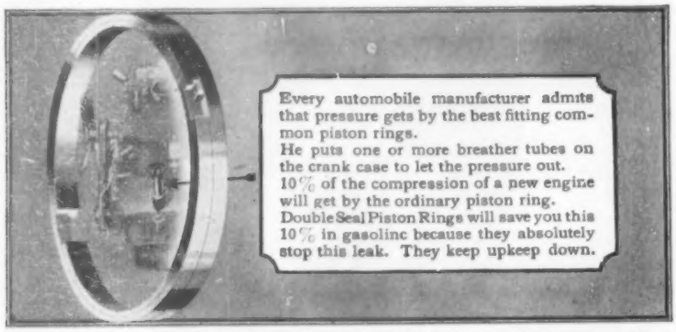

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ly suited; for it makes it feasible to equip every car with its own drive. The multiple-unit train, where every car or every other car is self-impelled, exerts a much augmented tractive effort, so that it can reach full speed in a brief while after a stop. Where high-voltage, direct current is used, on the other hand, the locomotive is relied upon generally to do all of the pulling, and only its driving wheels are tractors. Accordingly, it takes longer to acquire or to resume maximum headway, and the condition of the tracks may interfere with this to such an extent as to impose the hauling of fewer cars.

On mountain sections, where high-voltage alternating-current distribution is provided, and the locomotives are driven by induction motors, the problem of handling heavy freight trains is radically modified for the better because of the uniform pace and good speed which these tractors can maintain both up and down grade. Further, this type of tractor places a minimum burden on the brake installation.

In densely settled areas, railway electrification has occasioned two reflex vexations. Alternating-current systems give rise to a phenomenon known as inductive interference, which is apt to upset the operation of nearby telegraph and telephone lines. This annoyance has been pretty effectually reduced by the proper bonding of the rails so that the return circuit is taken care of in a way to obviate the disturbance of neighboring systems of communication. Inductive interference, like a mischievous boy, promptly betrays its activities in an audible manner. Direct current, however, promotes the electrolysis of underground conduits, etc.; and the extent of its silent, insidious and destructive work is very frequently not detectable until collapse of the pipes, structure, etc., takes place. Then the damage may be of a very costly nature.

It is probable that no one system will be accepted to the exclusion of all others, but when a system is selected for a given railroad the decision should be made only after careful consideration not alone of the problems of that particular line but also of those of its neighbors—in this way achieving as complete a measure of unification as is economically possible.

California's Seaweed Industry

(Continued from page 445)

The process of manufacture is ingenious and interesting in view of the fact that they designed all the machinery and equipment for a purpose entirely new. The whole takes seventy-two hours but operation necessarily is continuous. The leaves and stems of the algæ are used. One of the most clever conceptions in the factory is a battery of four "mortars" or bowls twenty-two inches in diameter and fourteen deep in a solid block of concrete, with corresponding quadruple wooden "pestles"—an adaptation on a modern mechanical scale of the primitive method of grinding. Into these mortars the raw material or dry weed is first placed and in a few minutes it is stamped into a fine mass. The object is to free it of the millions of tiny shells, bits of sand, alkaline deposits and other foreign matter. Then it goes through various tanks and vats, one containing a secret solution for bleaching and the others plain water for washing, after which it is run through a wringer and spread on racks to dry in the California sun. It looks like white moss.

Next it is boiled three to four hours, filtered, distributed in galvanized iron trays four feet long, two wide and three inches deep, and five hours later it comes out jelled, like a large sheet of rubber. In this form it comes to the sharp knives of another wonderful machine, which cuts it into pieces a foot long and two inches square, each intact but sliced lengthwise as are noodles. Having now undergone extreme heat a siege of the opposite character is provided, for it is placed on wooden trays and carried into a great refrigerating room and for ten hours kept at ten degrees below zero. The sticks come out solid ice. They are slowly melted, the water drained off, then put through a forcing machine which flattens each "noodle" into a thin, transparent sheet. Again the California sun is invoked to dry them. Finally they are tied in three-pound sheaves of silvery sheen, and thus they first go into the market.

The factory is also making a superior vegetable isinglass as an experiment and the owner believes he can approach in quality, at low cost, the Russian mineral isinglass now selling for $11.50 a pound. An adhesive plaster, photographic films and other products are included in his plans, which thus far have in nowise been disappointing. Potash, iodine and other by-products of the algæ will be conserved, appliances for that purpose being in course of installation.

Edison's Views on Life and Death

(Continued from page 446)

lions upon millions of entities, and that our body and our mind represent the vote or the voice, whichever you wish to call it, of our entities.

"Now let's see why we must be composed of life entities. Supposing you take a finger print of your thumb, in the conventional manner of the police records. Then burn your thumb sufficiently to destroy the skin. Do you know that after the new skin has formed the finger print of your recovered thumb will be precisely the same as the first one? Yes, absolutely the same, even down to the last line and irregularity. I tried it to make sure. Here is a mystery which has remained unanswered until now.

"Of course, you say it is nature. But what is nature? That seems to me to be such an evasive reply. It means nothing. It is just a subterfuge—a convenient way of shutting off further questioning by merely giving an empty word for an answer. I have never been satisfied with that word 'nature.' Now my answer is that the skin didn't happen to grow that way again by accident. Someone had to plan the new growth and to supervise it to make certain that it would conform in every way with the old skin. You do not know just what that pattern is, and so your brain plays no part in the operation.

"Here is where our life entities come into action. I firmly believe that the life entities rebuild that thumb with consummate care, drawing upon their remarkable memory for all the details.

"Let us consider an analogy, for the sake of making my point more clear to you. Supposing that a man from Mars came to this earth, and his eyes were so much coarser than ours that the smallest thing he could see was the Brooklyn Bridge. He could not see us. Naturally, he might take Brooklyn Bridge for some natural growth, just as we consider grass, sand, minerals and other things as matters of natural development. Supposing that same man from Mars were to destroy the Brooklyn Bridge, and several years later he happened to find a new bridge in precisely the same place and of precisely the same design. Would it seem logical for that man to assume that the bridge simply grew again in the same manner and in the same place? Don't you suppose that the Martian would be compelled to assume that some intelligence and guided effort were behind the rebuilding of the structure he had destroyed?

"That is precisely the stand we should take regarding the life entities. Obviously, the entire matter is one of conjecture. Perhaps the entities in our bodies are ninety-five per cent workers and five per cent directors. At any rate, it is the ensemble of all these entities which gives us our physical form, mental properties, personality, and so on.

"The entities are life, I again repeat.

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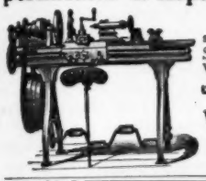

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They are steady workers. In our bodies these entities constantly rebuild our tissues to replace those which are constantly wearing out. They watch after the functions of the various organs, just as the engineers in a power house see that the machinery is kept in perfect order. Once conditions become unsatisfactory in the body, either through a fatal sickness, fatal accident or old age, the entities simply depart from the body and leave little more than an empty structure behind. Being indefatigable workers, they naturally seek something else to do. They either enter into the body of another man, or even start work on some other form of life. At any rate, there is a fixed number of these entities, and it is the same entities that have served over and over again for everything in this universe of ours, although the various combinations of entities have given us an erroneous impression of new life and still new life for each generation.

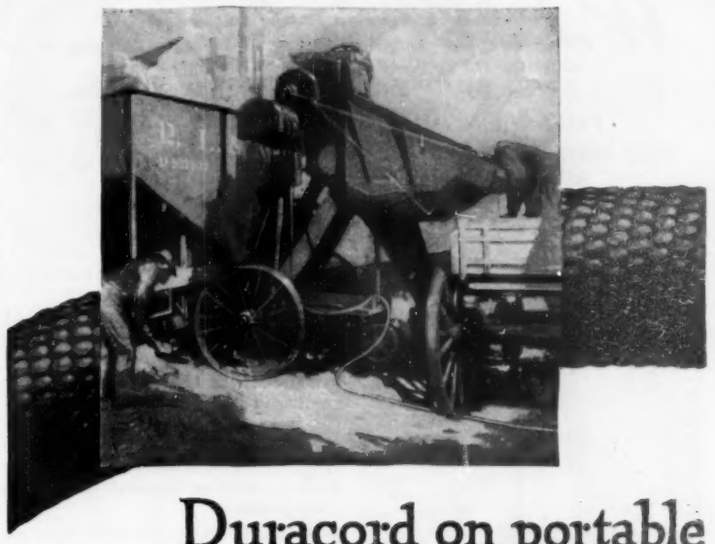
"The entities live forever. You cannot destroy them, just the same as you cannot destroy matter. You can change the form of matter; but of gold, iron, sulfur, oxygen and so on, there was the same quantity in existence in the beginning of this world as there is today. We are simply working the same supply over and over again. True, we change the combinations of these elements, but we have not changed the relative quantities of each of the elements with which we started. So with the life entities, we cannot destroy them. They are being used over and over again, in different forms, to be sure, but they are always the same entities.

"The entities are so diversified in their capabilities that it is difficult to identify their handiwork in all instances. Thus today the scientists admit the difficulty of drawing a line of demarcation indicating where life ends and inanimate things begin. It may be that life entities even extend their work to minerals and chemicals. For what is it that causes certain solutions to form crystals of a very definite and intricate pattern? Nature! But what is nature? Is it not fair to even suspect that life entities may be at work building those crystals? They don't simply happen. Something must cause certain solutions always to form certain kinds of crystals.

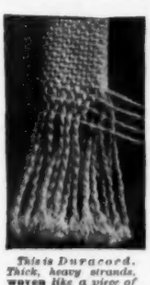
"Now we come to the matter of personality. The reason why you are Lescarboura and I am Edison is because we have different swarms or groups or whatever you wish to call them, of entities. After eighty-two remarkable surgical operations the medical world has conclusively proved that the seat of our personality is in that part of the brain known as the fold of Broca. Now it is reasonable to suppose that the directing entities are located in that part of our bodies. These entities, as a closely-knit ensemble, give us our mental impressions and our personality.

"I have already said that what we call death is simply the departure of the entities from our body. The whole question to my way of thinking, is what happens to the master entities—those located in the fold of Broca. It is fair to assume that the other entities, those which have been doing purely routine work in our body, disband and go off in various directions, seeking new work to do. But how about those which have been directing things in our body—those which are Lescarboura, Edison, Meadowcroft and so on? Do they remain together as an ensemble or do they also break up and go about the universe seeking new tasks as individuals and not as a collective body? If they break up and set out as individual entities, then I very much fear that our personality does not survive. While the life entities live forever, thus giving us the eternal life which many of us hope for, this means little to you and me if, when we come to that stage known as death, our personality simply breaks up into separate units which soon combine with others to form new structures.

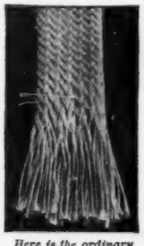
"I do hope that our personality survives.



Duracord on portable coal conveyors



This is Duracord. Thick, heavy strands, woven like a piece of fire hose, not braided. Picture shows outside covering only with impregnating compound removed.



Here is the ordinary braided cable covering. Note the open and porous construction, easily cut, stretched or unraveled. Compare it with the illustration of Duracord above.

PICTURE the wear it gets. Dragged around the yard, run over by heavy wagons, walked on, buried under falling coal—Duracord defies it all.

This sturdy portable electric cord is made for just such service. It has a big thick *woven* fabric covering that accepts its full responsibility and never lays down on the job. It outwears ordinary cord many times.

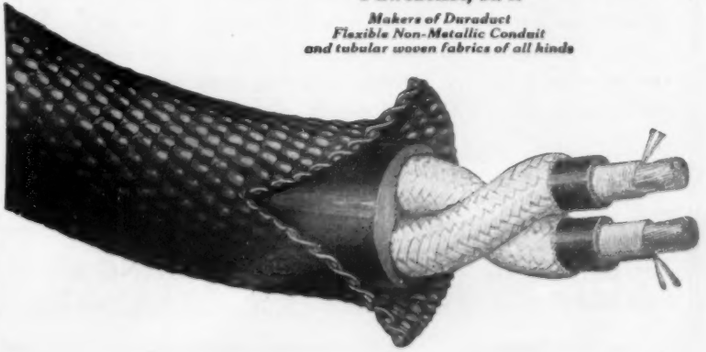
DURACORD
TRADE MARK REGISTERED

In addition to portable conveyors, Duracord is used on magnetic cranes, mining machinery, locomotive headlights, cement mixing machines, welders, portable electric tools, extension lamps—wherever the ability to stand hard knocks is an asset.

Duracord is made in all sizes of portable electric cord and the larger sizes of single and duplex cable. Ask your electrical jobber or let us send you samples of Duracord and ordinary cord for you to test and compare yourself.

TUBULAR WOVEN FABRIC CO.
Pawtucket, R. I.

Makers of Duraduct Flexible Non-Metallic Conduit and tubular woven fabrics of all kinds



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If it does, then my apparatus ought to be of some use. That is why I am now at work on the most sensitive apparatus I have ever undertaken to build, and I await the results with the keenest interest."

Getting a Line on Concrete Pipe

(*Continued from page 449*)

type of the finished product can be compared with other joints of pipe made of specially prepared mixtures, the comparison reflecting the character of materials, proportions, water content and other ingredients.

Permeability tests are conducted upon the completion of the tensile-strength investigation, the same specimens being used. A concrete block, one side of which conforms to the inside surface of the specimen, constitutes the testing apparatus. It is held against the surface by two clamps. Water is furnished through a one-fourth-inch iron pipe running through the tester to the surface to be tested. Escape of water is barred by an inflated gasket seated in a groove around the edge of the tester. Fifty pounds of water pressure is applied for one-half hour. The quantity of sweat or seepage is noted at 5-minute intervals. Specimens are air-cured 29 hours and water-cured 3 weeks. Absorption tests are made on the same specimens. These are dried out in an electric oven to constant weight and then immersed in water. Weights are taken at one-half hour, 4 hours and 48 hours. The percentage of absorption is based on dry weight.

Definite results, although not comprehensive because of the incompleteness of the investigation, are available from the experiments. An outstanding conclusion is that proper grading of select material is the most essential factor in the manufacture of an excellent quality of concrete pipe. The porosity of a pipe is influenced largely by the grading of the material. Rock dust up to 10 per cent and clay free from organic matter up to 5 per cent have proven their efficacy in preventing seepage without decreasing the strength of the pipe.

Laboratory tests show that a substantially large variation in water content does not materially influence the strength of the pipe, conditional upon the mixture being heavily tamped. Under light tamping, pipe made of a so-termed "dry mixture" is much weaker and seeps freely. A first-rate quality of broken rock of uniform toughness insures the strongest pipe. This may be attributable to the difficulty of finding gravel free from soft or disintegrated particles in California. The breaking strength of concrete pipe under water pressures varies widely, the variation being due to the manner of testing. If a pipe is thoroughly saturated several days before the test is made a good quality of pipe will test as high as when dry, while a poor quality shows a decrease in strength of from 20 to 60 per cent.

That concrete expands and contracts when influenced by changes in temperature, is knowledge of general acceptance. However, the information that a concrete pipe expands when changed from a dry to a wet condition and contracts to a like extent when the conditions are reversed is not such common knowledge. A concrete pipe, when subjected to water pressure for some time, if permitted to dry, may contract as much as it would under a drop of temperature of 100 degrees Fahrenheit. Excessive internal stresses in concrete pipe, not infrequently resulting in ruptures, are created by having the lower part of a pipe line wet if not saturated and the upper part dry. Seepage through the shell of a pipe under water pressure will appear under low pressures nearly as rapidly as under high pressures. If water is going to percolate through a pipe, a pressure of 5 pounds to the square inch will indicate with reliable accuracy the quantity of water likely to pass through the shell.

Hardening Steel in Gas-Fired Furnaces

(*Continued from page 450*)

of quenching is not quite so rapid, or as severe as water or brine, yet quick enough to give the proper hardness to most all work.

It is important to keep all quenching baths cool, and replenished from time to time with a fresh supply of the liquid. Where water is used it is best to keep up a fresh supply continuously. Oil baths are cooled either by a series of cold water pipes around the tank, an agitation of the oil by compressed air, or a circulation of the oil. The last-named method is perhaps the best as it not only causes a cooling o fthe oil but also a constant changing of the bath and takes the heated oil away from the metal after it gives up its heat to the oil.

Quenching should be done rapidly but uniformly. Tongs for holding the work should have as small grip as possible. Long pieces of steel, including drills and reamers should be quenched with their axis vertical. Where this is impossible such as in very long round rods, they should be made to roll into the quenching bath with their long axis horizontal, but they should enter the bath very quickly. Round cutting tools should be immersed with their axis horizontal. Small tools or pieces should be kept in motion when placed in the cooling bath.

Warping occurs frequently in hardening steel pieces and may be attributed to one of two causes—uneven heating or quenching too long. Some pieces should be left in only long enough to harden extreme edges. Again it is often necessary to immerse the piece at an angle in order to overcome this difficulty. Therefore, it will be necessary to give considerable thought to the shape and design of the tool, in order to obtain the best results.

The Heavens in November, 1920

(*Continued from page 452*)

Jupiter is a morning star, rising at 1 A. M. in the middle of the month. Saturn is about seven degrees farther east, and rises half an hour later. The two planets are on the borders of Leo and Virgo, and afford a fine spectacle in the morning sky. Uranus is in Aquarius, observable in the evening, and Neptune is almost opposite in the sky, and visible before daybreak.

The moon is in her last quarter at 3 A. M. on the 3rd, new at 11 A. M. on the 10th, in her first quarter at 3 P. M. on the 18th, and full at 9 P. M. on the 25th. She is nearest the earth on the 27th, and farthest off on the 15th. During the month she passes near Neptune on the 3rd, Jupiter on the 5th, Saturn on the 6th, Mercury on the 11th, Venus on the 13th, Mars on the 15th, Uranus on the 18th, and Neptune again on the 30th.

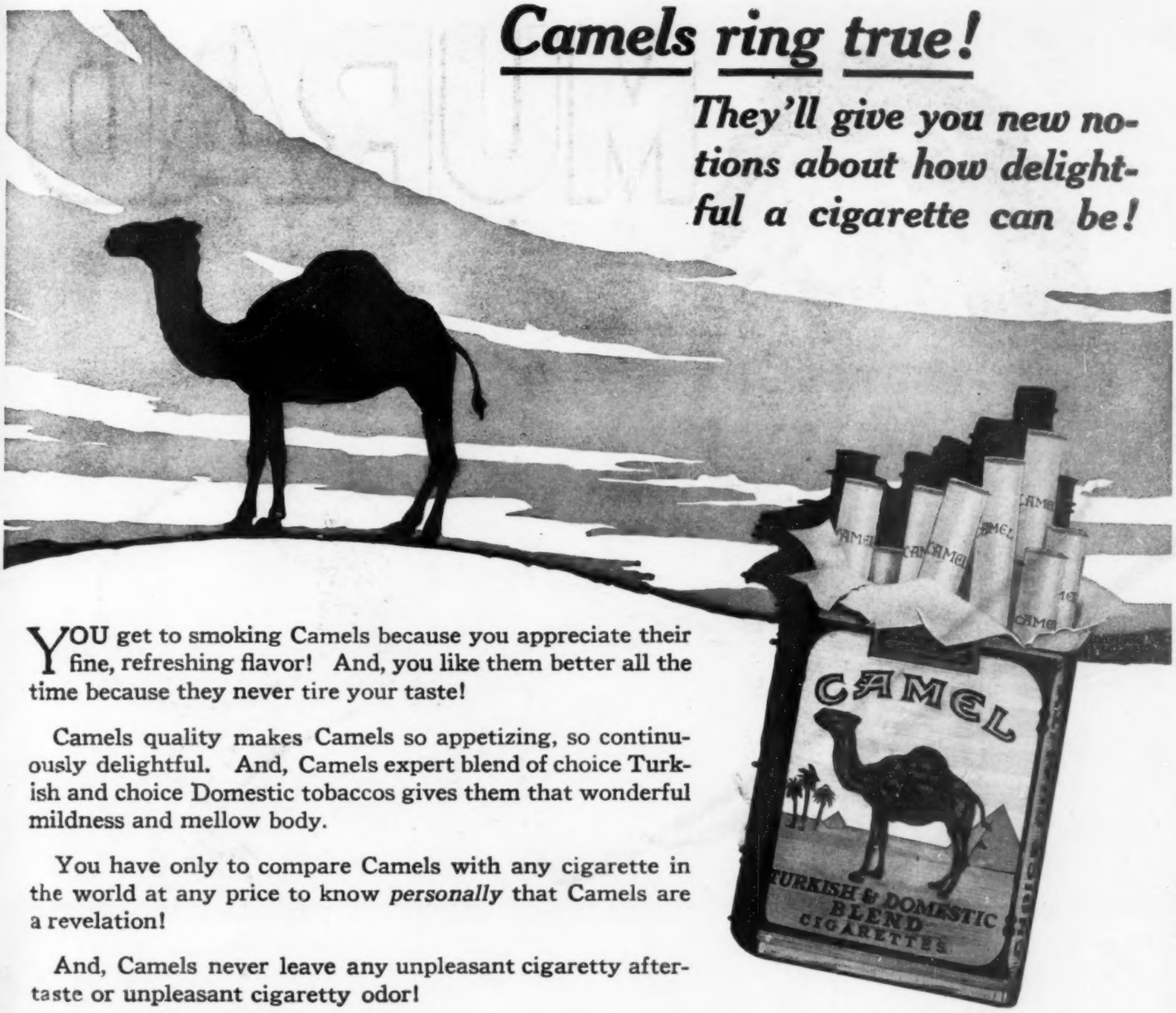
On the morning of the 10th there occurs a partial eclipse of the sun, which is visible throughout the northern and eastern portions of the United States, and as far west as Kansas. The eclipse begins about 9 A. M. eastern time and lasts more than two hours for observers in New England and the Middle States, about one-third of the sun's diameter being obscured on the northern side. The magnitude of the eclipse will be smaller, and the duration shorter for observers farther south and west, till it fades away to nothing in Alabama and Arkansas.

Do Moths Use "Wireless"?

IT has for long been known that certain species of moths are able to communicate with one another even though separated by a considerable distance. This fact is to be noticed very plainly during the pairing season. A female of the Vapourer Moth (Orayia) may be enclosed in a wooden pill box. She will then attract males from all directions, and these will come from a distance of a mile or two.

Camels ring true!

They'll give you new notions about how delightful a cigarette can be!



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